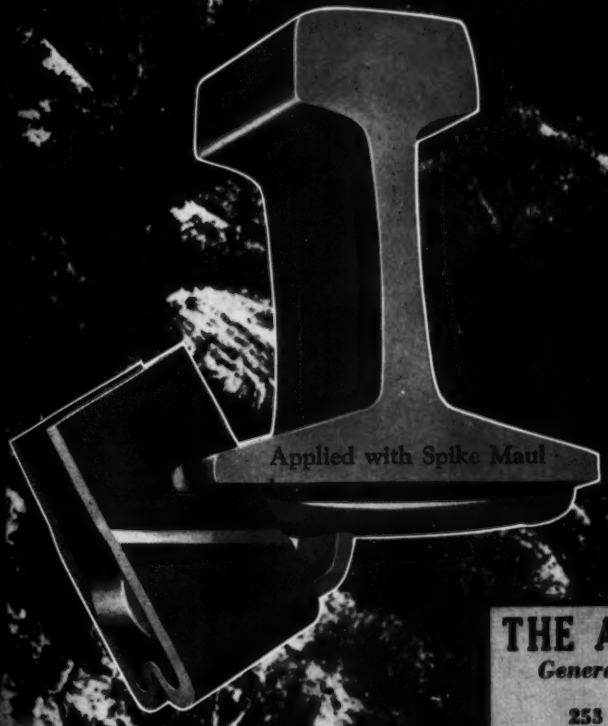
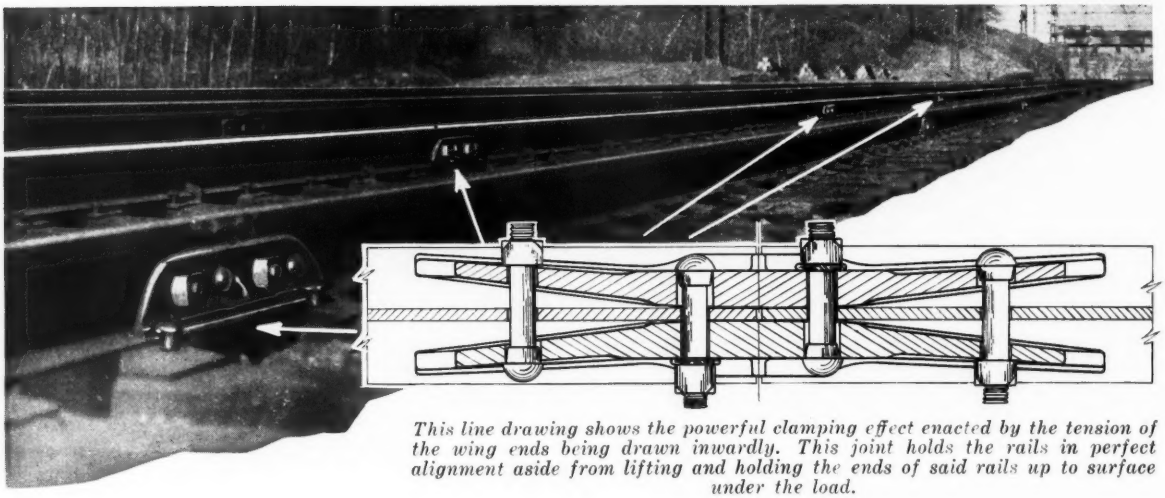
April, 1932

Railway Engineering and Maintenance



"STEAD"
TRUE TEMPER
RAIL ANCHOR
Initial and Application
Costs Low

THE AMERICAN FORK & HOE COMPANY
General Offices: Cleveland, O. *Factory: North Girard, Pa.*
District Offices
253 Broadway, New York City - Daily News Plaza, Chicago, Ill.
Representatives at
Boston, Denver, Detroit, Louisville, Minneapolis, St. Louis and San Francisco
Foreign Representatives
Wenham, Inc., 44 Whitehall St., New York City, and 69-72 Windsor House, Victoria St., London, S.W.-1



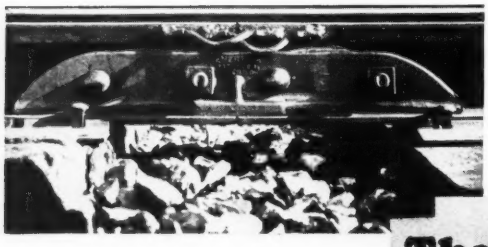
This line drawing shows the powerful clamping effect enacted by the tension of the wing ends being drawn inwardly. This joint holds the rails in perfect alignment aside from lifting and holding the ends of said rails up to surface under the load.

SAVE YOUR RAIL

EVERTITE bars will prolong the life of your worn rail—adding many years of service. Keep your steel in the track and at the same time, enjoy direct economies by the use of this new, improved rail joint.

Steps of vast importance have been taken in the industrial arts during the last generation. Some of the major ones are the automobile, the improved highway, radio, moving picture and the airplane. A comparable improvement was due in rail joints. It is here in the EVERTITE bar, with its "*mechanical man*" always on guard, with its constant spring tension to take up slack and keep the rail ends up to surface.

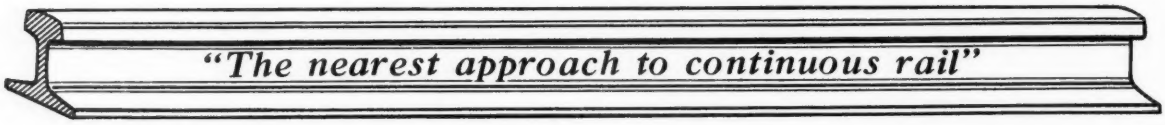
EVERTITE rail joints supply the service need and reduce maintenance costs while doing so.



STANDARD EQUIPMENTS INC.
415 Lexington Avenue NEW YORK

Complete Details
And Performance Records
On Request

The EVERTITE Rail Joint



RAILWAY ENGINEERING AND MAINTENANCE
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Alphabetical Index to Advertisers, Page 294

6 CROSS TIE BULLETIN *January, 1932*

Roads Saved $33,000,000 on Cross Ties in 1929

Further Saving of $22,000,000 in Annual Renewals Held Possible

ACCUMULATED benefits from the practice of protecting cross ties from decay and wear were responsible for saving at least $33,000,000 for the Class I railways in 1929, states the Railway Age, in one of a series of articles on operating economies. In that year, according to statistics of the Interstate Commerce Commission, these railways renewed 74,679,375 cross ties at a total outlay of $100,585,843. Seventy nine per cent of these ties, or 59,047,380, were replaced by treated ties that cost $1.46 in track, while the remainder (except for a few steel and concrete ties) were of untreated wood that cost $0.93 in place. The renewals in 1929 represented an average replacement of 209 ties per mile of track (excluding the mileage laid with switch and bridge ties) out of a total of 2,974 ties per mile, which is equivalent to an average life of 14.2 years. If the railways had previously made all their renewals with untreated ties giving an average life of 7½ years, thereby requiring the annual renewal of 400 ties per mile, they would have been compelled to replace about 143,000,000 ties in 1929, which at a cost of $0.93 in place, would have required an outlay of $133,000,000.

This accomplishment is by no means all that the railways can expect as the result of proper preservation and adequate protection of their ties. The attainment of a life of 14.2 years is only a fair performance compared with the results obtained on individual railways, some of which are renewing less than 100 ties per mile per year. If, therefore, the Class I railways should obtain an average life of 20 years from their cross ties, and this is by no means an unreasonable assumption, for it is already being exceeded by several roads, their annual requirements would amount to about 150 ties per mile, and they would then need to replace only 53,500,000 ties (on the basis of the present Class I mileage), which, at a cost of $1.46 per tie, would represent an outlay of $78,100,000. Thus, it is not at all unreasonable to assume that they can effect a still further saving of at least $22,000,000 in their annual tie renewals.

Whether this saving or an even larger sum is to be realized will depend on the extent to which the roads as a whole adopt, and rigidly adhere to, the practices observed by those roads which are now obtaining the longest life from their cross ties. There is no short cut to good results. Rather, the answer is to be found in scrupulous attention to details—a purchasing policy that embraces a rigid adherence to specifications as to both size and treatment from decay, collection and yardage practices that will insure against decay after delivery, treatment that is adequate and adapted to the climatic conditions of service, effective protection of the ties from mechanical deterioration and supervision of the track forces that will insure against abuse and premature removal. These measures seem almost too obvious to deserve mention, but there is ample evidence that deviation for "practical" or "business" reasons has not infrequently resulted in a loss of useful tie life which far outweighed the temporary

There is opportunity also to improve the protection afforded the ties against mechanical deterioration. Larger tie plates of better design, with faster tie

plate relative to the tie are among the developments of recent years that will make for longer service life of cross ties. The railways that have made the longest use of these more advanced forms of construction are among those that now enjoy the lowest tie renewal records.

Specify
LUNDIE
for
BETTER DESIGN

There is opportunity also to improve the protection afforded the ties against mechanical deterioration. Larger tie plates of better design . . . will make for longer service life of cross ties.

THE Lundie Tie Plate has that better design—therefore insures the utmost in tie conservation—maximum tie life—minimum tie renewals.

This scientifically designed plate has a canted bottom with well-rounded parallel undulations which hold track to rigid gauge. The Lundie is the ONE plate, which under heaviest loads, merely compresses the fibres of the ties—NEVER CUTS THEM. The Lundie never splinters the timber or cuts deep pockets which hold water, start and accelerate decay. Therein lies the supremacy of the Lundie design.

The economical distribution of the metal in the Lundie Plate insures maximum strength at minimum cost.

Specifying Lundie Plates now will insure immediate as well as continued economies.

The Lundie Engineering Corporation

285 Madison Avenue, New York
59 East Van Buren Street, Chicago

150,000,000 IN SERVICE PROVE THE ECONOMY OF THE LUNDIE PLATE

LUNDIE TIE PLATE

smooth riding TRACK *increases* PASSENGER BUSINESS

Even under the highest possible standard of maintenance, rail with battered or chipped ends will not ride well. • Reduced purchases of new rail is no longer a valid excuse for the irregularity of track surface resulting from batter. The Oxweld Process of building up rail ends, with metal harder than the original rail, makes old rail ride like new. The cost of welding is more than offset by the reduced cost of joint maintenance and the decreased cost of new rail is clear profit.

The Oxweld Railroad Service Company

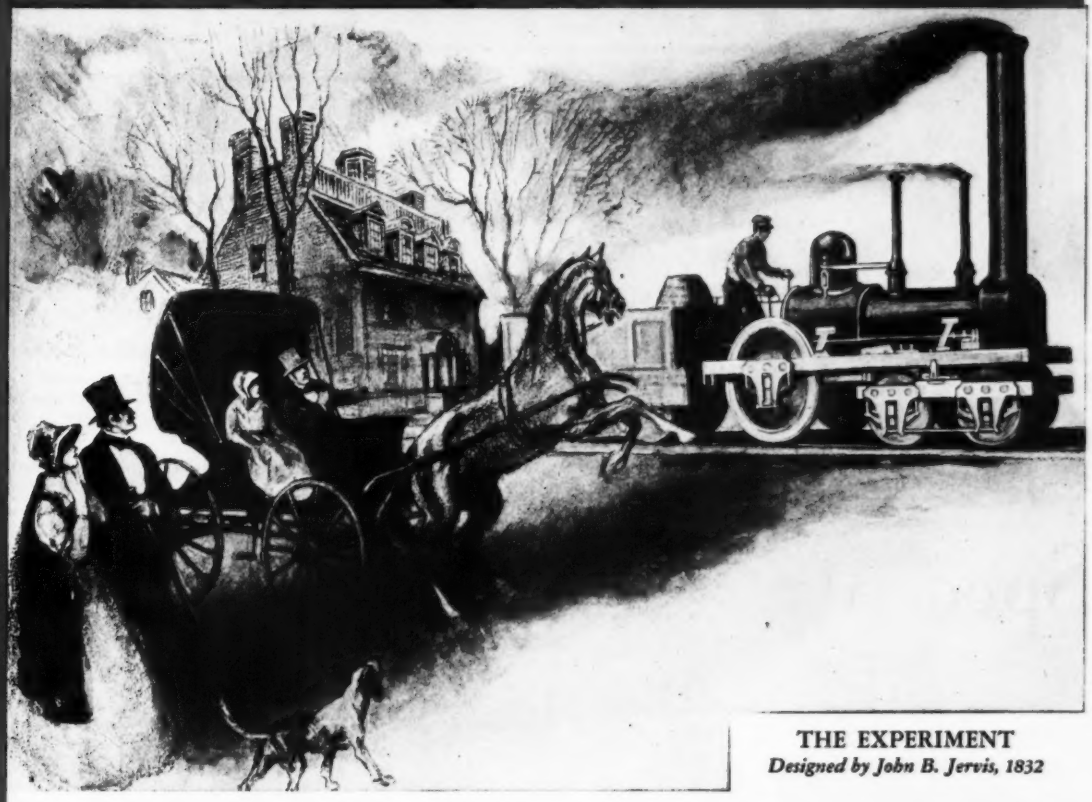
Unit of Union Carbide and Carbon Corporation

UCC

NEW YORK, Carbide and Carbon Building

CHICAGO, Carbide and Carbon Building

EXPERIMENT . . . . .



THE EXPERIMENT
Designed by John B. Jervis, 1832

Experiment—what a world of meaning is hidden in the word. Someone christened John B. Jervis' locomotive "The Experiment," yet it made a world's record of eighty miles per hour.

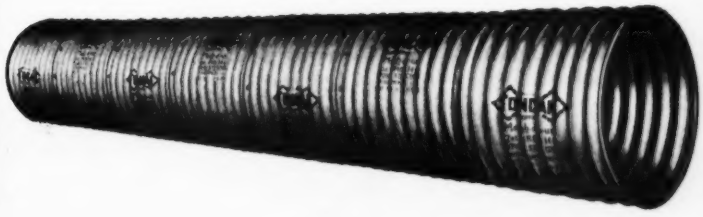
Some have referred lightly to Toncan Iron as an experiment. True, but Time has proved the value of this material from which the world's long-lasting culverts are made.

As a matter of fact, Toncan Iron will always be an experiment. Whenever research or experience proves that the addition of another element or a refinement of process will bring greater benefits, Toncan Iron will change to keep step with progress, but it will continue to bring to buyers of culverts the best value that their money can buy.

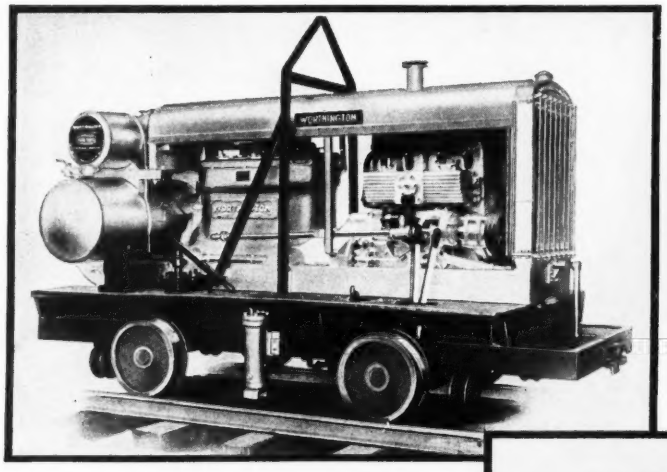
The story of Toncan Iron is one of change—from pure iron to an alloy of refined iron and copper. Later, the addition of molybdenum and increased copper brought added advantages. But you're not buying metal—it's long life and dependability you're looking for, and you'll find it in culverts of Toncan Iron—the always modern alloy.

TONCAN CULVERT MANUFACTURERS' ASSOCIATION
YOUNGSTOWN, OHIO

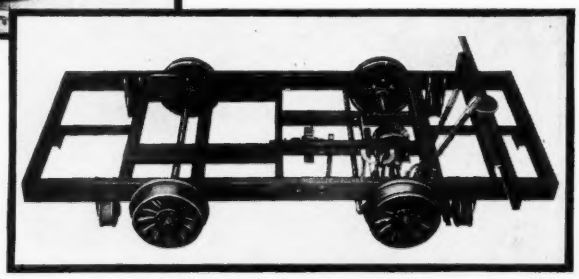
TONCAN
IRON CULVERTS



THE WORTHINGTON *AIR KING* COMPRESSORCAR . . . A TRACK MAINTENANCE POWER PLANT



Above view shows easy derailing operation . . . raising ends of car with jack permits operator to place cross ties under transverse derailing wheels



Specially designed *for Railroad use*

THIS portable compressor has been developed for railway work with a full consideration of the present-day demand for ample air supply and reliable operation.

Its compact well-balanced appearance is indicative of the careful designing effort that has been devoted to it . . . and of the advanced engineering features which it incorporates.

In the compressor unit . . . simple long-life Feather Valves, full force-feed lubrication, drop-forged counterbalanced crankshaft, automobile type pistons, extra large cooling water jackets, divided flow cooling system delivering cooled water direct to compressor from bottom of radiator.

In the engine . . . over 25% reserve horsepower, oil cooler, removable cylinder sleeves, Robert Bosch Super-energy Magneto, oversize centrifugal cooling water pump, sectional radiator.

In the mounting . . . welded rolled steel frame, Timken Roller Bearing journal boxes, bevel gear reduction drive to wheels through air-cooled clutch.

Four sizes of machines are available . . . 120, 240, 280 and 330 cu. ft. displacement. Selection of mountings includes self-propelled and non-self-propelled rail cars, steel wheels, rubber tire wheels and wood skids.

Ask the nearest Worthington office for literature and further information on these machines.

WORTHINGTON PUMP AND MACHINERY CORPORATION

WORKS AT BUFFALO, N.Y. CINCINNATI, OHIO HARRISON, N.J. HOLYOKE, MASS.
Executive Offices: 2 Park Ave., New York, N.Y.
GENERAL OFFICES: HARRISON, N.J.

COMPRESSORS *Portable and Stationary*	PUMPS *Centrifugal...Steam...Power Rotary...Deep Well*
ROCK DRILLING EQUIPMENT	FEEDWATER HEATERS
Rock Drills	CONDENSERS and Auxiliaries
Contractors Air Tools	
Drill Steel and Accessories	METERS *Water...Grease Oil...Gasoline*
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R-102

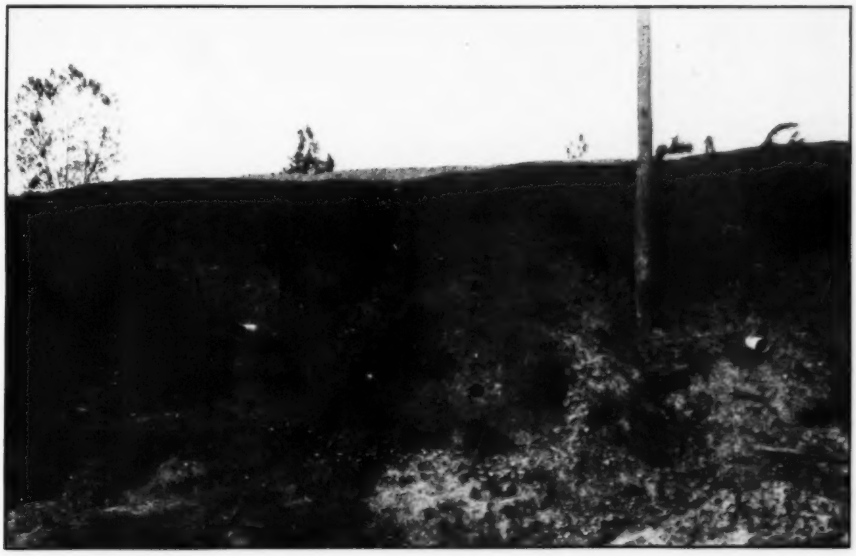
WORTHINGTON

PREVENT SLIDES

with

ARMCO *Perforated* PIPE

Quickly and Economically



15 lines of 8-inch Armco Perforated Pipe were used to remove the cause of a slide at Spencerville, Ind.

PREVENTING this costly menace to roadbed and traffic is one of the several difficult subdrainage jobs entrusted to Armco Perforated Pipe on many railroads.

Water, which is almost always the underlying cause of slides, is intercepted and carried off by Armco Perforated Pipe before it makes the area unstable. The perforations are large enough to admit all water freely, yet small enough to exclude soil particles. Additional advantages are: *Adequate strength* against crushing or pulling apart in unstable or shifting soils, as provided by the corrugated metal type. *Proved durability* as assured by Armco Ingot Iron, Nature-tested 26 years to date. *Ease* and *low cost of handling* and *installation.*

Armco Perforated Pipe also is used to tap water pockets, to eliminate soft spots and heaving, to quickly remove surplus water around track pans, and to provide better subdrainage wherever it is needed.

Facts on the performance of Armco Perforated Pipe in slide areas and in other types of service are yours for the asking.

Armco Culverts and drains are manufactured from the Armco Ingot Iron of The American Rolling Mill Company and always bear its brand.

Other Armco Drainage Products

Paved Invert Pipe
Part Circle Culverts
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Multi-Plate Pipe
Metal Cribbing

ARMCO CULVERT MANUFACTURERS ASSOCIATION
Middletown, Ohio

Gentlemen: Send me at once facts and data on Armco Perforated Pipe

Name_____

Title_____

Road_____

Address_____

City_____

R. E. M. 4

GEO

insures DOUBLE SATISFACTION

GEO . . the modern solution to track problems . . guarantees satisfaction from two distinct angles. For the passenger is provided smooth and practically noiseless track, greater speed and greater safety. This should be reason enough to dictate the selection of GEO. What is more important than passenger satisfaction? Yet this modern method of track construction has many other points of superiority. Control of rail movement, reduction in rail wave motion, longer life of rails and ties, radically reduced maintenance costs . . . . these are advantages which maintenance of way men cannot afford to overlook.

G E O is not a new, experimental device. Many thousands of miles of G E O track have been laid in Europe during the past five years and new construction is adding several thousand miles yearly. Here in America, test sections on leading railroad systems are demonstrating G E O to be the most important contribution to railroad track construction of the past decade.

Descriptive literature will be sent at your request, and Carnegie Engineers are at your service at all times.

GEO TRACK CONSTRUCTION

CARNEGIE STEEL COMPANY - PITTSBURGH

Subsidiary of United States Steel Corporation

143

● *Saucer used to make "Saucer Test" for paint durability. Made of steel, 5½ inches in diameter by ⅝ inch deep. Write for testing saucer and sample of red-lead. Prove to yourself that Dutch Boy Red-Lead is your property's best safeguard against rust.*

Prove for yourself that

RED-LEAD OUTWEARS

other primers for metal

● **Here is a paint durability test which may be the means of saving you hundreds...even thousands...of dollars. It's the "Saucer Test"—an easy, practical way to prove that pure red-lead gives iron and steel structures superior protection against rust.**

The "Saucer Test" was originally developed by the engineering department of a large southern railroad as a means of determining the lasting qualities of paints for metal. This railroad found that the "Saucer Test" made it possible to practically duplicate the rigorous conditions which paints encounter in railroad service. Another large paint buyer used the "Saucer Test" to study the destructive action of brine on metal protecting paints. Other companies in widely different industrial fields are constantly finding additional ways to use the "Saucer Test" in determining paint quality.

With the "Saucer Test" you can readily reproduce the particular corrosive conditions to which your iron and steel structures are exposed...it is equally adaptable to railroad, industrial, marine, oil field and other applications. For example, cinders and water in the saucer will set up the sulphuric acid reaction that occurs when locomotive cinders and moisture collect in the webs of bridge girders. A brine solution will enable you to determine the most durable paint for metal exposed to sea water or salt air. Or you can use other solutions which most closely approximate the rust-forming conditions peculiar to your property.

The railroad that originated the "Saucer Test" has tested scores of metal protecting paints. In these tests pure red-lead has outlasted every other primer by at least 4 to 1. Others have used the "Saucer Test" with results that speak just as well for the protective properties of pure red-lead.

Why not prove to your own satisfaction that Dutch Boy Red-Lead protects iron and steel structures better than any other primer for metal? Let us send you a testing saucer, together with instructions for making the "Saucer Test"—and a sample of Dutch Boy Red-Lead, ready for the brush. Just address your request to our nearest branch.

● *Dutch Boy Red-Lead is a fine, highly oxidized red-lead supplied in two forms—paste and liquid. The paste comes in natural orange red, is readily mixed to brushing consistency and can be tinted to darker colors. Dutch Boy Liquid Red-Lead (ready for the brush) is available in the natural orange red, two shades each of brown and green, and also in black.*

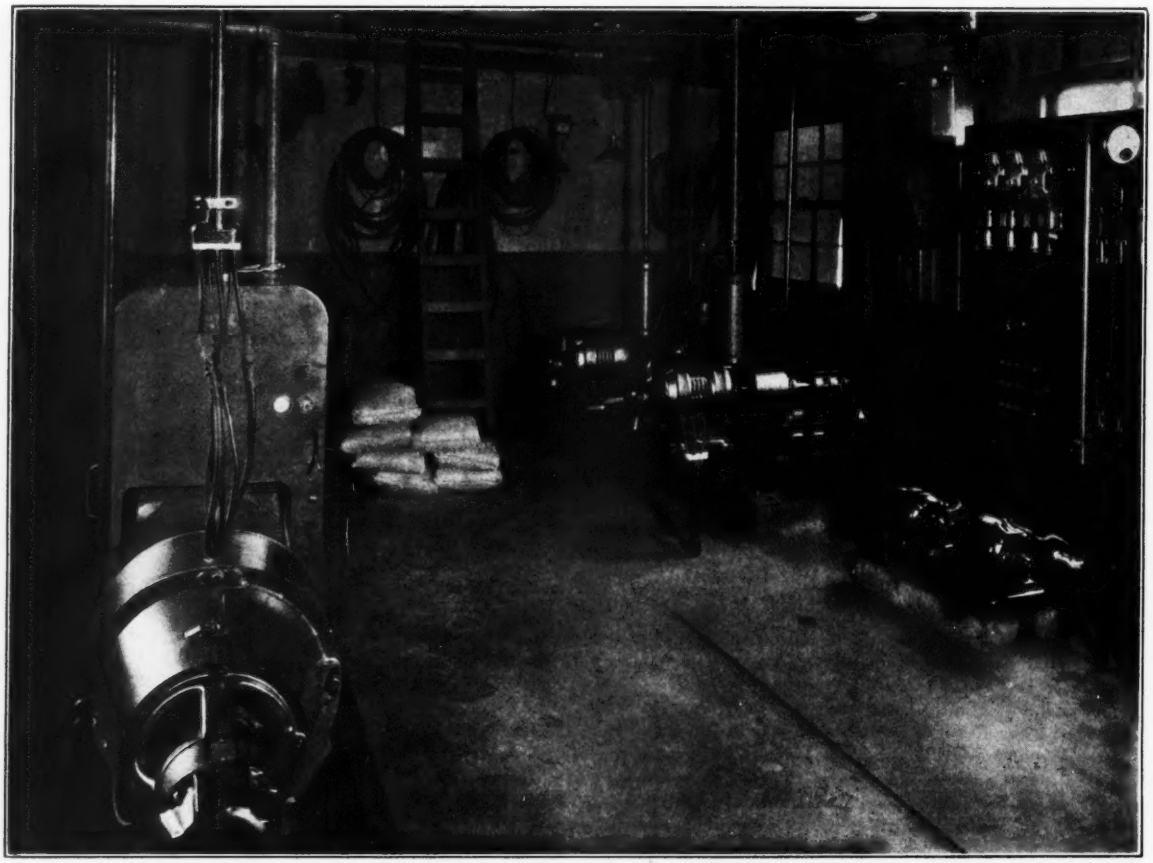
NATIONAL LEAD COMPANY

111 Broadway, New York; 116 Oak Street, Buffalo; 900 West Eighteenth Street, Chicago; 659 Freeman Avenue, Cincinnati; 820 West Superior Avenue, Cleveland; 722 Chestnut Street, St. Louis; 2240 Twenty-fourth Street, San Francisco; National-Boston Lead Co., 800 Albany Street, Boston; National Lead & Oil Co. of Pa., 316 4th Avenue, Pittsburgh; John T. Lewis & Bros. Co., Widener Bldg., Philadelphia.

DUTCH BOY RED-LEAD

ELECTRICITY IS THE MODERN POWER

—GAS-ELECTRIC—
POWER-PLANTS



SYNTRON POWER PLANT SUPPLYING A. C. CURRENT AT INTERLOCKING PLANT

A.C. OR D.C.

GAS ENGINE DRIVEN ELECTRIC POWER PLANTS—
2 KW. TO 75 KW.

MANUAL, REMOTE OR FULL AUTOMATIC CHANGE OVER OPERATION

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INTERLOCKINGS	COMPRESSING STATIONS	WELDING PLANTS	STATIONS
PUMPING STATIONS	SAWING AND ADZING PLANTS	SHOPS	OFFICE BUILDINGS
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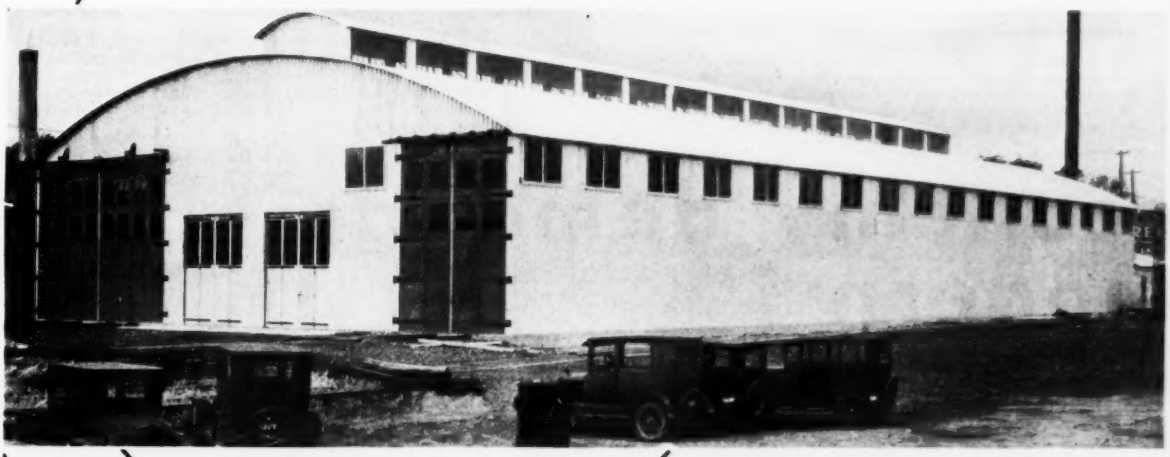
PITTSBURGH **SYNTRON CO.** PENNA.

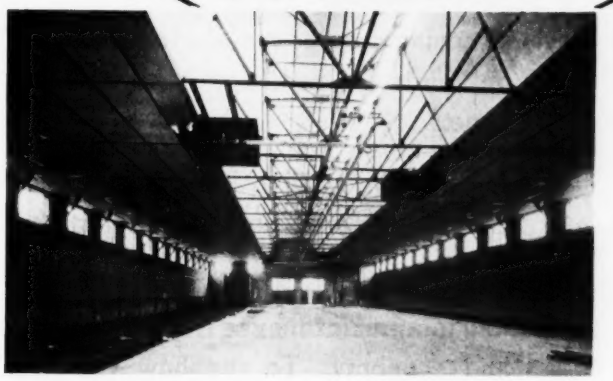
Mfrs. of SYNTRON ELECTRIC TIE TAMPERS

MADE ENTIRELY OF STEEL

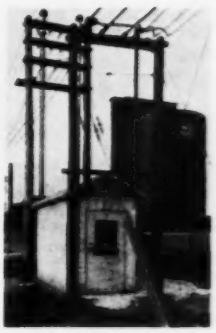
BUTLER



READY-MADE STEEL BUILDINGS



At the top right is a photograph of the structural steel frame which carries the C. B. & Q. Fruit House. Its members are designed to give the greatest strength per pound of steel and fabricated in units such as to facilitate quick assembly. The large photograph shows the finished building with the panel corrugated wall and roof sections bolted into a finished exterior. The special Butler panel corrugation multiplies sheet steel strength fourfold over ordinary corrugating. The interior view above the inside insulation is accomplished with Nu-wood, a commercial wall board. Insulation and heating facilities are such as to maintain a 50 degree temperature in coldest weather.



Fruit Houses . . . Car Repair Shops . . . Truck and Bus Garages . . . Material Depots and Treating Plants . . . Scale Houses . . . Track Car Houses . . . Machine Shops . . . Signal Towers and Transformer Houses . . .

These . . . and many other railway structures . . . are now ready-made of steel . . . fit into railway economy programs better than any other fire-safe type of construction.

Standardized unit design facilitates quick assembly on location, enlarging, taking down and re-erection . . . complete, ready-made materials in orderly arrangement promote quick installation without interruption . . . permanence is inwrought in both materials and structural design.

The standardized unit design of Butler Ready-made Steel Buildings is flexible. Butler engineers gladly collaborate to incorporate the ideas of railway engineers to fulfill particular requirements.

BUTLER MANUFACTURING COMPANY

1247 Eastern Ave.
KANSAS CITY, MO.

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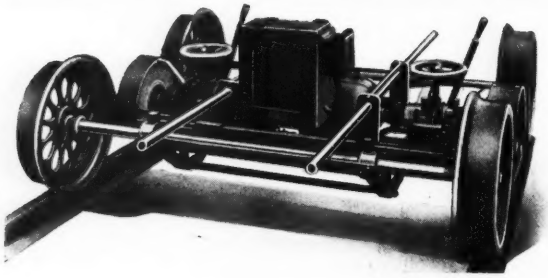
Send complete information on Butler Ready-made Steel Buildings, particularly a building approximately .....ft. by..... ft., to be used for .....

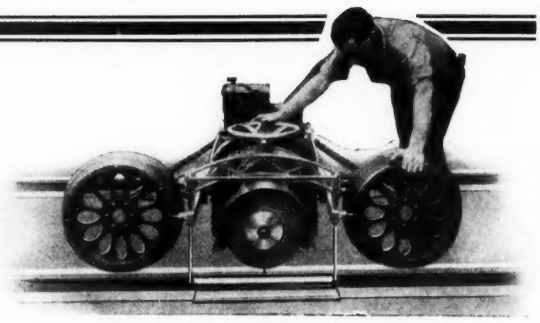
Firm Name.....

Address .....



Railway Track-work Company Portable Track Grinder, Model P-2

Two grinding heads operating independently, one on each rail. Electric motor driven. Grinding wheel operates at 9000 surface ft. per min., feed regulated by hand wheel. Grinds gauge line or outside of rail. Derailing rollers raise grinder clear of track.
P-4 same as above except operated by gasoline engine.



Railway Track-work Company Portable Track Grinder, Model P-3

Grinding wheel operates on either rail. Single throw hand lever operates a jack enabling operator to swing machine for grinding opposite rail. Grinds gauge line or outside of rail at 9500 surface ft. per min. Electric motor driven. Quickly adjusted roller permits speedy derailing. Model P-6, same as above except that it is operated by a gasoline engine.

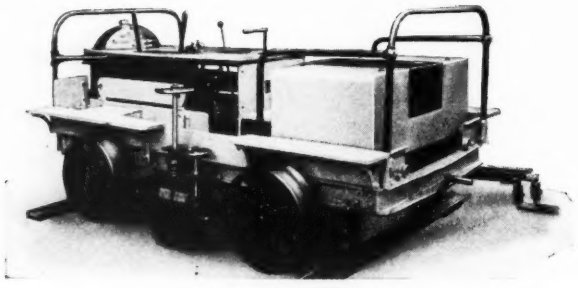
economy demands modern equipment • • •

Maintenance of track, foundation of successful railroading, has long called for cost-cutting equipment to replace outworn methods.

With the modern rail grinding equipment shown on this page, the cost of removing surplus metal after building up joints by welding, is cut to the bone.

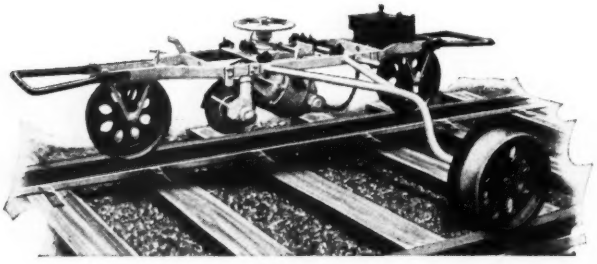
In addition, the job is done with machine shop precision, preserving the rail.

Rail joint maintenance is vital to safety and economy. To see how you can reduce the cost, get bulletins describing this equipment.



Railway Track-work Company Portable Reciprocating Grinder, Model P-7

Propelled and operated by 40 h.p. Ford Industrial gasoline engine. An economical machine for surfacing joints in new track. Grinds by reciprocation instead of rotation. Produces a smooth surface, maintains original rail contour, removes minimum metal. Two grinding blocks on each rail make 200 strokes per min. Quick derailing.



Railway Track-work Company Portable Electric Track Grinder, Model P-8

Two wheels on one rail. Outrigger on opposite rail, quickly removable, permits parking grinder on neutral ground to pass train. Electric motor operates grinding wheel at 9000 surface ft. per min. Adjustable laterally and vertically. May be reciprocated 16-in. Flexible shaft carries grinding wheel for beveling joints.

Railway Track-work Co.

3132-48 East Thompson Street Philadelphia

MOLES

Moles clean ballast, between tracks or on shoulder, without train interference.

Moles are working on fifteen railroads, cleaning the greater part of all the stone ballast being cleaned in the United States.

Individual Moles have cleaned over fifty miles in a single season.

RAILWAY MAINTENANCE CORPORATION
Pittsburgh, Penna.

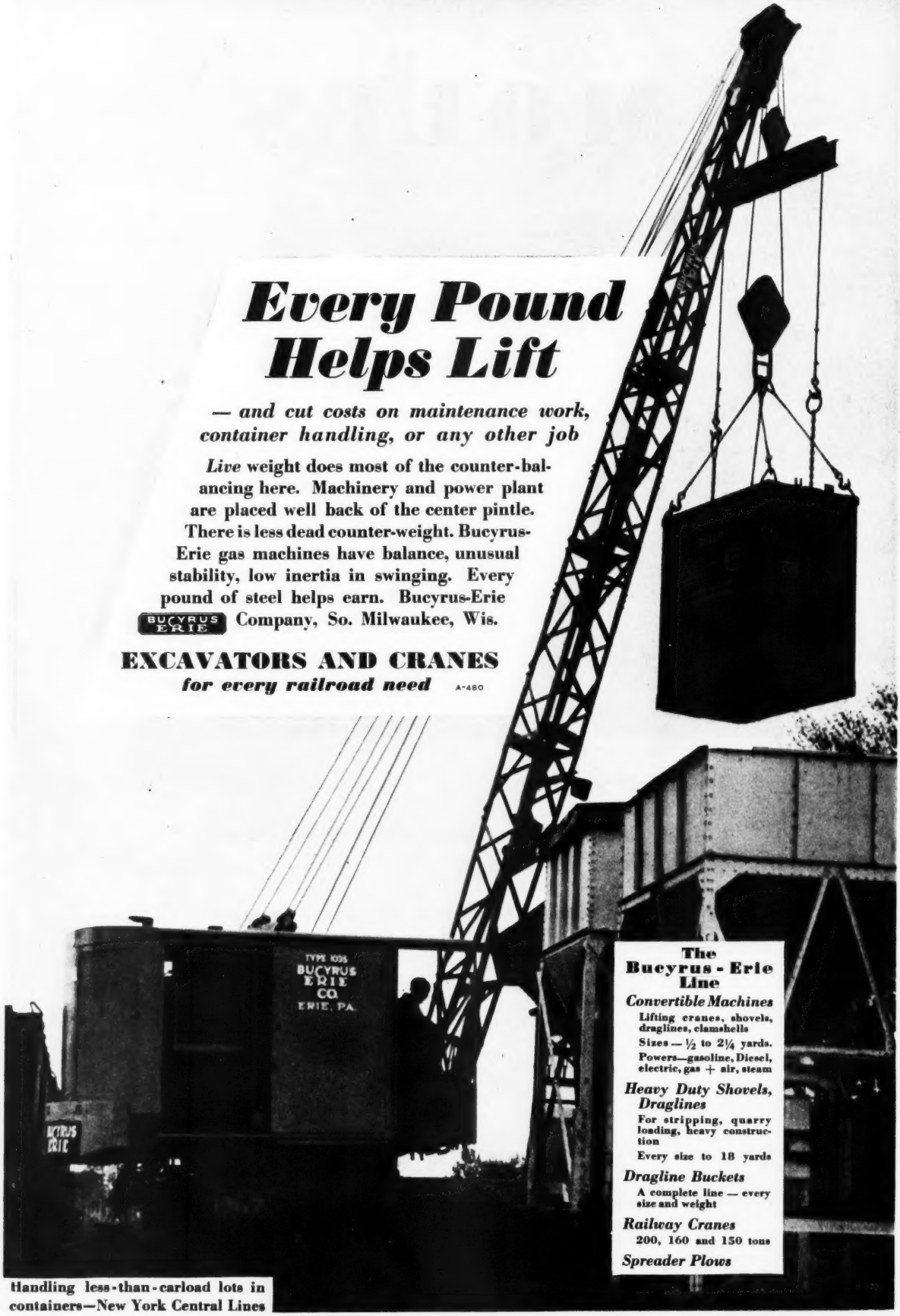
Every Pound Helps Lift

— and cut costs on maintenance work, container handling, or any other job

Live weight does most of the counter-balancing here. Machinery and power plant are placed well back of the center pintle. There is less dead counter-weight. Bucyrus-Erie gas machines have balance, unusual stability, low inertia in swinging. Every pound of steel helps earn. Bucyrus-Erie Company, So. Milwaukee, Wis.

BUCYRUS ERIE

EXCAVATORS AND CRANES
for every railroad need A-480



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SOMEBODY Piled up These "Overtime" Costs

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ENGINE FAILURE STOP COMING IN WITH DOUBLE HEADER STOP
ONE DEAD ENGINE STOP DOUBLE CREW WITH OVERTIME=
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No. 40 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY
105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: An Editor's Mistakes

March 31, 1932

Dear Reader:

I wonder if you have ever given any thought to the high degree of accuracy that is expected of an editor of a business paper such as Railway Engineering and Maintenance. In many respects his work is very similar to that on a newspaper; yet, the person who will condone the most glaring inaccuracies in his daily paper, will not infrequently show the greatest intolerance over a single error in his business paper. Yet the possibility of error here is almost equally great.

To illustrate, in a description of a new unit of equipment, in a recent issue of one of our associated publications, we stated that this incorporated the latest devices in its field. To our surprise we received a criticism from one of the interested parties that this equipment was of a design two years old and since superseded by a later model. While it would appear to be a fair assumption that when a road spends more than $50,000 for such equipment it would be of the most modern design, this assumption appears to have been in error and we confess to an inaccuracy.

This incident calls to mind the old clipping that every editor keeps under the glass on his desk:

When a lawyer makes a mistake, he tries the case over again.
When a plumber makes a mistake, you have to pay for it.
When a doctor makes a mistake, he buries it.
When a judge makes a mistake, it becomes the law of the land.
When a preacher makes a mistake, no one knows the difference.
When an architect makes a mistake, you get a bill for the extras.
When an editor makes a mistake, Good Night!

To insure that high degree of accuracy that is expected of us, every article that appears in this paper is written or edited by a member of our staff who is himself familiar with the problem in question through practical railway experience. Each article is then passed to a second editor, similarly qualified, who check-reads it for correctness of facts, as well as for accuracy of presentation. After being set in type and checked by an experienced proof reader, the article is read again by a member of our staff as a further last minute precaution against errors. It is through such measures that we endeavor to bring to you information which you can rely on as to accuracy of facts.

We appreciate the tribute that is implied in the criticisms that come to us occasionally. We accept such criticisms as a recognition of the fact that a high degree of accuracy is expected of the editor of a business paper. We are doing our best to measure up to such standards.

Yours truly,

Elmer T. Howson
Editor.

ETH*JC

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What's the next JOB?

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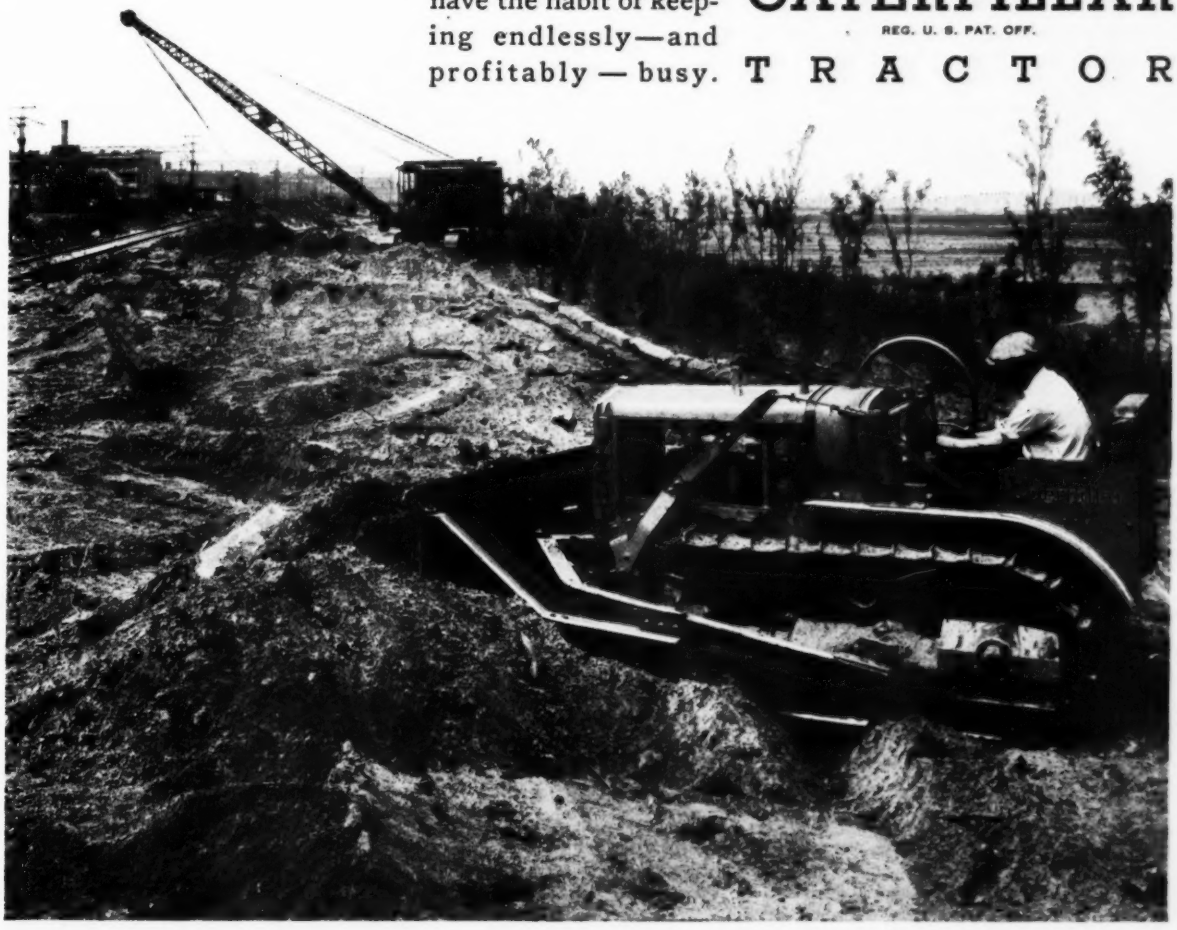

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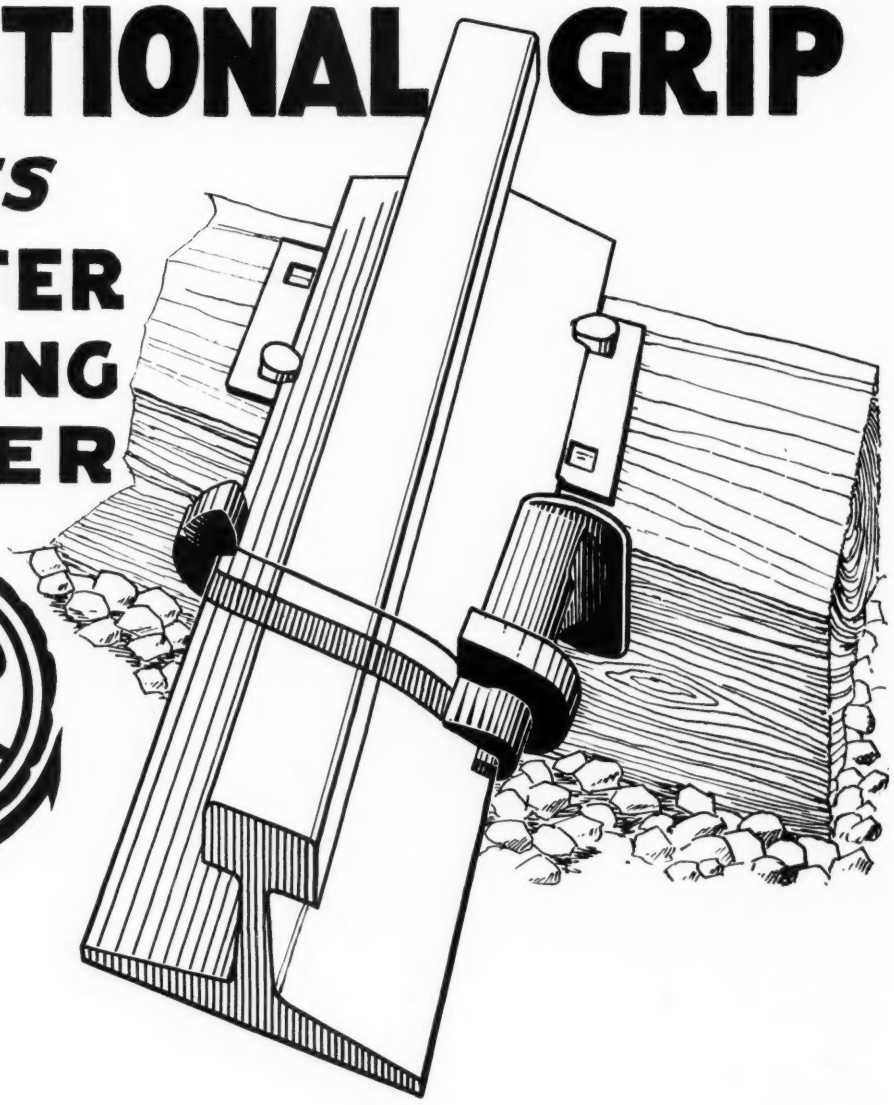

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310 SOUTH MICHIGAN AVE. CHICAGO

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

APRIL, 1932

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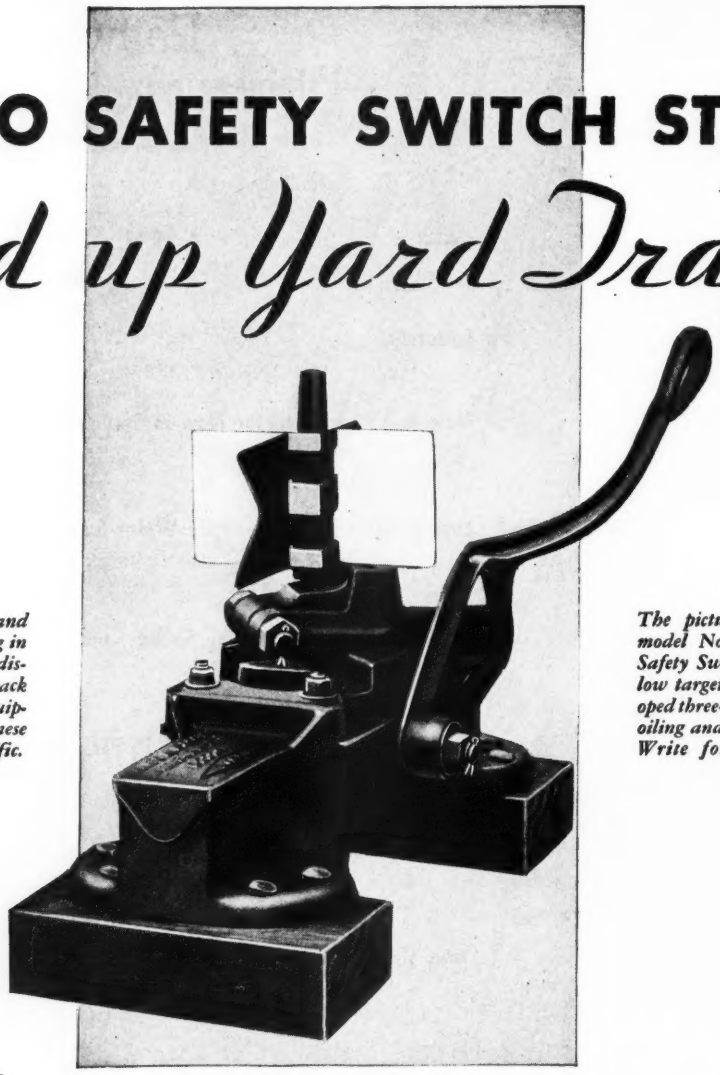
RAMAPO SAFETY SWITCH STANDS

speed up Yard Traffic

Behind Racor Service stand nine plants specializing in the manufacture and distribution of railroad track turnout and crossing equipment, including Manganese Work for heavy traffic.



The picture at left is a model No. 20 B Ramapo Safety Switch Stand with low target. A newly developed three-piece cover makes oiling and inspection easy. Write for information.

IN THE rapid handling of cars during switching operations there is the ever-present chance of shunting cars through closed switches with resultant damage to switch points and rigid switch stands. Regardless of the known hazards of such miscalculations, and in spite of the discipline with which switching crews are imbued, mishaps of this kind are frequent. Invariably, with rigid switch stands, they result in delay and expense. This constant threat of trouble makes men over-cautious and slows up their work.

RACOR TRADE MARK REG. U.S. PAT. OFF.

Ramapo Safety Switch Stands completely eliminate all the penalties of trailing through closed switches. When this occurs, a spring mechanism allows the points to move over under pressure of the wheel flanges and properly carry the car on its way. No damage is done to the points or to the switch stand. The target follows the points and indicates their true position, whether thrown automatically or by hand.

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Railway Engineering and Maintenance

TAXATION

Burden is Limiting Railway Employment

NO subject is so prominently before the American public at the present time as that of taxation, with reference especially to the necessity for relief from the burden that is crushing corporations and individuals alike. On the one hand we find the politicians striving to balance budgets by devising new or heavier forms of taxation. On the other hand we find the public almost universally demanding budget equalization through the curtailment of public expenditures.

This question is of vital importance to every employee of a railway; it is of scarcely less concern to the employees of those companies which depend in whole or in part on railway purchases for their business. It is of concern to them as tax payers, direct and indirect. It is of still greater moment by reason of its effect on the ability of the railways to continue to provide employment. For this reason, it is to the interest of every person dependent on the prosperity of the railways to so inform himself regarding the full import of the present tax burden that he may lend his efforts to the correction of those conditions which are now acting so adversely to his welfare.

A Rapidly Mounting Burden

That the rapidity with which the burden of taxation has grown may be properly appreciated, it may be pointed out that in 1913 total railway earnings were slightly more than $3,000,000,000, while total expenditures for government were slightly less than that amount. In 1931, in contrast, total railway earnings had risen to approximately $4,300,000,000, while total government expenditures approximated $14,000,000,000. In other words, the amount which the public paid for transportation increased 34 per cent in the last 18 years, while the amount which it paid for government rose nearly 400 per cent or 12 times as fast.

Studies made by the National Industrial Conference Board shows that taxes constituted a charge of $107.37 on every man, woman and child in the country in 1929. Nor was this the end, for the net expenditures of the federal government alone were 6 per cent greater in 1930 than in 1929, and they increased 14 per cent more in 1931, until they are at the present time exceeding income to the extent of $7,000,000 a day. Nor does this trend differ from that which prevails among the more than 250,000 other tax collecting and tax spending bodies in the United States. As a result, our multiplicity of federal, state and local governments are now taking in taxation one dollar out of every $4.50 earned. To illustrate the magnitude of this toll, in the state of North Carolina, which is not the most flagrant governmental unit which might be cited, the cost of government equals the value of the three major crops produced in that commonwealth.

More specifically as affecting the railways, their tax accruals amounted to $308,000,000 in 1931, as compared with a net income available for the owners of the properties aggregating only $141,000,000. In other words, for every dollar of net income earned for the stockholders, the roads paid $2.18 to federal, state and local tax collectors last year. This net income was the lowest for any year since 1897. In that year, it is esignificant to note that taxes aggregated only $41,000,000, equivalent to 48 cents for every dollar of net income. It is in no small degree because of this excessive increase in taxes that the railways and other industries have been forced to resort to such drastic retrenchment measures and to reduce employment so severely.

Where the Money Goes

So much for the burden. It is also of interest to note the purpose for which this tax money is being spent. Much criticism is being directed, and justifiably so, to the variety of useless expenditures that are being made to carry on the many activities of government bureaucrats, ranging from the preparation and distribution of booklets to inform our citizens that window curtains "not only keep out the light but insure privacy," and to advise the housewives how to make rompers for little Johnny, to studies of the activities of lightning bugs and of the love habits of bull frogs.

Open as such inconsequential activities are to attack in these days of universal conservation of expenses in private business, they are less objectionable and harmful to railway employees than some of the other expenditures for which large sums derived from taxation are being spent. For instance, of the $1,990,000,000 expended by the states in 1929, the outlay for highway construction constituted the largest single expenditure, totaling $669,000,000, exclusive of all federal aid, and the amount so spent was still greater in 1930 and 1931. This vast sum constitutes a subsidy to a form of transportation that is competing unfairly with the railways and is taking much business from them, accentuating the effects of the depression and contributing in no small part to the necessity for reduced railway employment. Again the national and local governments are spending millions of dollars to make the Mississippi, the Missouri, the Illinois and other rivers navigable for the purpose of providing other

subsidized competition for the railways and diverting from them still more traffic. The deficits incurred in the operation of these waterways likewise are met by public funds derived from taxation, levied in part on railways and railway employees.

Typical of these deficits that railway employees are being required to aid in meeting is one that is being incurred at Peoria, Ill. Here the city, although served by 12 railroads, voted $400,000 in bonds with which to build a terminal for barges on the river front. Advocates of this bond issue told the voters that this terminal would pay for itself in a few years. The annual charge for interest and amortization of bonds amounts to $30,881 over a period of 18 years, and this sum does not include insurance on or maintenance of the facilities. The barge line pays as rental to the city 15 cents per ton on all revenue freight handled. Through the last season, this freight averaged 4,000 tons per month, bringing the city a return of $600 per month or at the rate of only $5,400 per year, based on the nine navigable months. To pay its way, this terminal must handle more than 300,000 tons of freight annually, a figure beyond the fondest hopes of anyone conversant with the situation. Yet, the construction of this terminal was characterized as a public achievement of such magnitude that the secretary of war of the United States came all the way from Washington, with prominent officers of the United States army, to participate in its opening.

Public Works Not the Answer

Akin to expenditures of this kind, attention may be directed to another campaign that is now being promoted aggressively in certain quarters to secure authorization by Congress of expenditures for a greatly enlarged public works program, including $120,000,000 for highways, under the guise of unemployment relief. Being built with public funds, such projects must necessarily be financed through public taxation, adding still further to the burden that is driving the railways and other industries to the wall and forcing them to make still greater reductions in their forces, thus adding to the unemployment which it is sought to relieve.

It is not irrelevant here to point out that the unemployment from which we are suffering today did not originate with governmental activities (for the number of persons on public payrolls has increased rather than decreased during the depression) but resulted from the inability of industry to continue operations at the normal rate and one of the principal reasons for its inability to continue these operations is the excessively heavy taxation. Relief will be effected only by restoring industry itself, including the railways, to normal vigor. This will be effected by reducing rather than increasing the burden of taxation. When this is brought about, industry will itself be able to provide increased employment.

Railway Employment Curtailed

The railways are one of our greatest industries. They normally provide employment for 1,750,000 persons, and indirectly, through their purchases of materials and supplies, to probably an equal number in other industries. Their ability to provide this employment, directly and indirectly, at reasonable wages, has been seriously restricted during the last two years. That this has a direct effect on railway employment is shown by statistics compiled monthly by the Interstate Commerce Commission. The latest figures show that, on January 15, the total number of employees of the Class I roads (those with gross earnings of $1,000,000 or more annually) was 1,108,699, as compared with 1,333,820 for the same period a year ago and 1,594,744 on January 15, 1929. In other words, the number of employees declined 16.9 per cent during the last year and 30.4 per cent in the last three years, while it was 625,625 less than in August, 1929. Nor does this tell the entire story, for many of those employees are now working part time as a further measure of retrenchment. As a result, the railroad payroll for 1931 was $813,687,403 less than in 1929.

The fight to curb public extravagance is the business of every alert citizen. It is a challenge especially to railway employees because of the fact that portions of these taxes are being devoted to fostering competing forms of transportation which tend to reduce railway traffic and railway employment. Railway employees owe it to themselves to make known their demands to those who represent them in public office to the end that public expenditures may be reduced to the minimum required for the legitimate functions of government and the railways may be permitted to lead the way back to normal earnings and normal employment.

GUARD RAILS

Should They Be Provided on All Bridges?

THE decks of railway bridges have been provided for years with what are generally known as guard rails, but because they are of two types which may be classed roughly as inside and outside guard rails, and because practice varies as to their construction and use, there is still some misunderstanding as to their purpose and even more confusion in their designation. Thus, inside guard rails are often referred to as inside "metal" guard rails because T-rails are commonly used for this purpose, although some roads use timbers faced with structural steel angles. In similar manner, the outside guard rails, because they are usually of timber, are often designated as "wooden" guard rails, although steel members have also been used for this purpose.

The report of a committee of the American Railway Bridge and Building Association, which appears on page 267 of this issue, clearly defines the primary functions of the two classes of guard rails, but although the report indicates that outside guard rails are of doubtful effectiveness as a means of guiding derailed wheels, the committee's conclusions imply that some reliance can be placed on them in case of derailments. A similar lack of definiteness is found in the conclusions which the report quotes from the manual of the American Railway Engineering Association. In other words, while the outstanding superiority of the inside guard rail as a means of guiding derailed wheels is conceded, there is an obvious disinclination to go on record as to the necessity for providing any better protection than that

which is afforded by the outside guard rail.

Associations of railway men must, of cause, maintain a conservative attitude in expressing approval or disapproval of practices or appliances that bear on safety of railway operation because of the possibility that their conclusions may be used against the railways in the courts. This is especially true with respect to guard rails on bridges, because of the broad field that must be embraced in any consideration of the safeguards for trains in the event of derailment.

In the first place, the center of gravity of a present-day locomotive is so high that a lateral base width of only 4 ft. 8½ in. does not give assurance that a derailed engine will stay upright if derailed at high speed even if guided by guard rails. In the second place, who will say how much more hazardous a derailment is on bridges of various classes than on a high embankment or an embankment supported on one or both sides by retaining walls? In brief, many factors enter into the answer which cannot be evaluated with mathematical exactness or by the enunciation of any simple rule. But in spite of this, it is well to recognize that guard rails placed between the running rails are far more effective in guiding derailed wheels than guard rails at or near the ends of the ties.

SECTION GANGS

What Will Become of Them in the Future?

IT IS difficult to arrive at any simple solution of the problem of reorganizing maintenance of way work to meet the changes in methods brought about by the introduction of power equipment. The problem arises in its most acute form in the section gang, which has always been considered by maintenance men as the backbone of track maintenance work.

All evidence points to a distinctly altered attitude toward this unit of the organization. While many insist that it must continue to occupy the foremost place in any plan for the upkeep of the tracks, there is no denying that many things have happened to it in the last ten years. Nearly all roads have lengthened sections to some extent and most of them report an appreciable transfer of the labor allotment from section forces to extra gangs or other working units in which more men are employed over more extended territories than that embraced in the typical track section. In some cases this has been carried so far that the section gang has been reduced to a foreman and one man, even during the so-called working season.

Whether this latter idea of the section gang will be put into general practice and whether its place in the picture will become even less important remain to be seen, because there are many officers of track maintenance, particularly in the supervisory class, who do not look with favor on the current tendency to pare down the section forces.

Among the reasons advanced by those who contend that the section gang must continue to hold an important place in the picture are the complete continuity of both roadway and track as compared with the more isolated character of bridges and buildings, the need for constant attention to a multitude of details which can be given only by forces that are regularly assigned to a limited territory, the advantage of maintaining a foreman on a section of track where he can become intimately acquainted with all of the conditions which surround it, and, not least in importance, the need for having men immediately available in any emergency.

Storms sometimes cause great damage and complete interruption to traffic through washouts, the blowing of trees and telegraph poles onto the track, the washing of sand or silt over the rails or the creation of rock or earth slides. In such emergencies the section gang because of its local character, is never far away, and proceeds to flag trains, notify the proper officers and repair such damage as it can before other help arrives. Similarly, in case of train accidents, the section gang is usually the first to arrive and undertake such work as is practicable until other forces are at hand.

How these emergencies are to be met by small and widely separated section gangs supplemented by larger units more remotely located is one point that must be covered in the development of plans for altering the track maintenance organization. Other conditions have changed, the track structure and roadway, thanks to expenditures for improvements, are now less frequently subject to failures that give rise to emergency work. The motor car, also, with the almost universal availability of telephones, has served to make the track forces much more mobile so that gangs can be marshalled at a given point from far greater distances without excessive delay.

This is an interesting period in track maintenance history, the progress of which will be closely observed by every progressive officer.

FLAWS IN RAILS

Progress in Their Detection and Study Continue

THE article on page 252, which discusses the detection of rail flaws and also describes the new detector car of the New York Central, serves to focus attention on the degree of refinement that is now being attained in this important work. Not only has the equipment been greatly improved but extended experience has taught skilled operators much that is invaluable in the interpretation of the record.

In the mean time work is in progress on the joint investigation of rails, fostered by the railroads and the rail manufacturers, and one ranking officer of track maintenance has gone so far as to predict that the cause of the transverse fissure will be conclusively established within the next two years. Others, however, are not so optimistic; the work is still in the preliminary stages and, as pointed out by Professor H. F. Moore of the University of Illinois, under whose direction the investigation is being carried on, its present stage is primarily that of determining the best methods of conducting the routine tests that are being planned. In the meantime, the search for flaws in rails must continue unabated.

The New Rail Flaw Detector Car of the New York Central with its Crew—Mr. Bronson Is Second from the left.

New York Central's

New Rail Flaw Detector

Now in Service

Self-propelled car embodies Sperry method and contains many features for expediting work and housing the crew

By C. B. BRONSON

Assistant Inspecting Engineer, New York Central Lines

THE New York Central has recently placed in service an installation of the Sperry rail flaw detector, which is mounted on a gasoline-electric rail car and is so arranged and equipped as to make possible the expeditious and accurate testing of rails in the track, and, at the same time, to afford maximum convenience and comfort to the detector operating crew. The new car, which was placed in regular service on September 29, 1931, has already tested a large mileage of tracks satisfactorily, and while its operation involves considerable expense, this expense seems justifiable in view of the added safety afforded in transportation.

Details of New Detector Car

The new detector car is equipped for self-propulsion, with double-end control for operation in either direction. The length of the car over the ends is 73 ft. 4 in., with the trucks spaced 54 ft. 6 in. center to center. The car is of ample weight (150,000 lb.) for the consistent operation of signals and meets all requirements of the signal department. Furthermore, it is equipped with automatic train control, a feature not incorporated previously in any of the detector cars.

The front end of the car houses the car propulsion power plant. This plant is a 350-hp. Hall Scott gas-electric unit, which has a range of speed from 5 miles an hour while testing, to about 55 miles an hour when not testing.

Immediately back of the power plant compartment are the living quarters, while directly back of these is a compartment which houses the engine-generator unit of the detector apparatus. The generator which is the same general type of unit used on other Sperry cars, furnishes the current necessary for the contact brushes of the detector equipment which travel along the tops of the two lines of track rails.

The rear compartment of the car, back of the engine-generator compartment, is approximately 19 ft. long. It is fitted with desk space, a repair and tool table, the relay and recording table of the detector equipment, and also with the control panel upon which are mounted the necessary meters and other indicating devices controlling the electrical features of the detector apparatus.

Standard Sperry equipment was used wherever possible in equipping the car, so that in most respects the detector unit conforms closely to those installed in the Sperry Company's own cars. The rail brushes and rigging, which are of rugged construction, can be raised vertically, this movement being controlled by air from cylinders located on the floor of the car in the engine-generator compartment.

The car can be stopped and started as readily as the double-unit type of detector cars previously in service on the New York Central. In addition, several marked advantages have been noted in the larger testing unit, including flexibility in getting in and out of traffic, and providing complete living quarters for the men, as well as certain equipment maintenance facilities. Still other advantages of the larger unit on a railroad system with the extensive mileage of the New York Central are the consistent operation of signals, automatic train control, and the higher speeds possible when not testing, permitting the rapid transfer of the unit from one location to another.

It may be of interest to know how the operators determine when a suspicious rail is detected by the equipment and what checks are made to insure that only

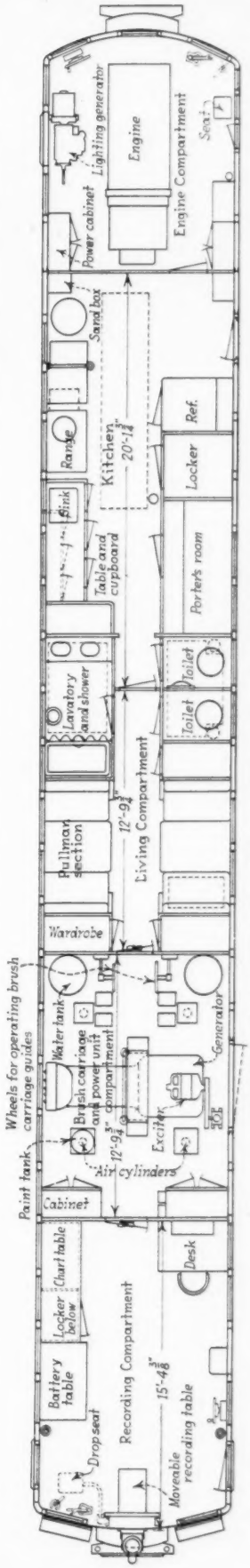
*Abstract of a paper presented before the New York Railway Club on January 15.

defective rails are removed. Briefly, the procedure is as follows: The operator, who watches both the tape and the track as the car moves along at a speed of approximately five miles an hour, is constantly on the alert to check the indications shown on the tape against such surface imperfections in the rail as burns, corrugations, flat spots, etc. If there is no evidence of a surface defect in the rail when one, two or three-pen indications of the recording equipment occur, the motorman is immediately signaled to stop the car, this being done by means of a push button within easy reach of the detector operator. The car is then backed up a distance sufficient that a repeat run can be made. If the rail is defective, the indications on the second run are generally stronger than those received on the initial run.

After the car has moved over the suspicious point in the check movement, it is again stopped, and a thorough visual examination is made of the rail in the vicinity of the suspicious point, by the operators and track representatives on the car. Points of suspicion in the rails are located approximately by means of guns which spray paint directly on the webs of the rails where flaw indications are received. In the eye inspections, search is made for cracks, crushed spots, slivers or other surface conditions which may have caused the pen indications. After the eye inspection at a specific point, the car is again backed up far enough so that conductors can be clamped on the rail head for hand test purposes. The hand test is made by using a sliding set of contacts connected to a portable galvanometer, and indicates the exact size and location of a defect. If the hand check shows a defect, the track forces are notified immediately to remove the rail. The defective rail is given a serial number and a record is made of its exact location as well as the name of the manufacturer, date rolled, heat number, etc.

Formerly, we assembled all rails indicated as defective and removed them to division or other points. Later, all rails containing interior transverse fissures or other defects not readily visible on the surface, were fractured. It is now required that each supervisor fracture all defective rails removed shortly after their removal, which furnishes a ready check on the efficiency and reliability of of the car.

In addition to the removal of rails which show clear-cut defect indications, it has been found expedient to remove some rails which give peculiar indications on the tape, and where the type of defect in the rails is, therefore, doubtful. This is done in order that these rails may be given special study. Ordinarily, it is not difficult to fracture the rails at the indicated points of defect, but cases have arisen where the rail fails



Floor Plan of the New Detector Car Showing the Arrangement of Space and Equipment

to fracture when bent at a defect point indicated by the hand test. In these cases the rail is cut to form a piece extending six inches each side of the indicated point of defect and the head is wedged apart lengthwise of the rail by a cold chisel. By this means, fissures are readily disclosed in many cases.

The crew consists of a motorman or engineman, two operators to handle the detector equipment, a cook, a conductor and a flagman. A representative of the maintenance of way department, generally an assistant supervisor of track, is also present on each subdivision, and makes the necessary arrangements with the track forces for the removal of defective rails.

With accumulated experience improvement has been noted in the efficiency and accuracy of the Sperry cars; the detector operators have also become more proficient in interpreting the indications shown on the record tape. The rate of growth of fissures, split heads, crushed heads, etc., is still a matter of considerable conjecture, which makes the need for frequent testing apparent, especially to those directly and closely associated with rail service problems. The frequency with which tests should be made depends upon many factors, among which are traffic density, loading conditions, speed of traffic, track alinement and grades, and the service history of each stretch of rails. In general, it is our aim to survey principal and high-speed tracks once each year.

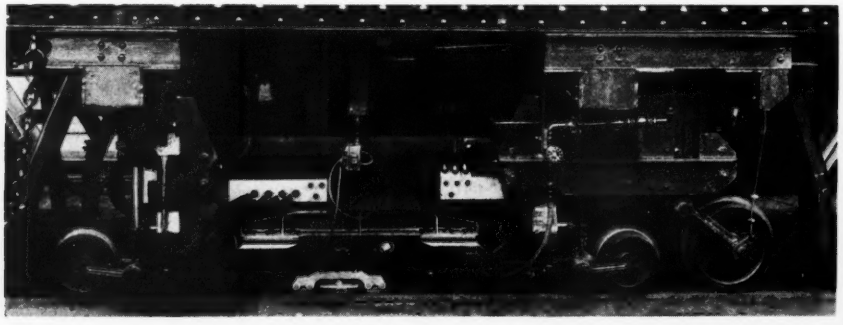
The original aim and ambition of Dr. Sperry was to perfect a car which would locate in rails in the track fissures which had developed to 20 per cent or more of the head area, which fissures cover the more important phase of the problem. With the greater perfection of the equipment, the detector cars have been able to locate fissures as small as 3 per cent of the head area. Furthermore, to the surprise of Dr. Sperry and others, the cars have been able to detect a variety of other rail defects, including splits in the web and base breaks, which had been considered outside the province of this type of testing.

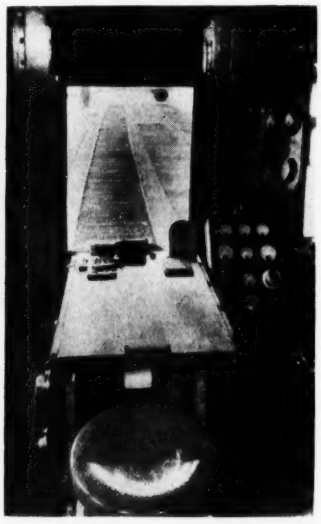
A study of the rails detected by the various cars used on the New York Central during two years of testing, in which over 6,976 miles of track were covered, developed that approximately 39 per cent of the defective rails contained flaws of the interior transverse-fissure type, while 61 per cent contained crushed or split heads or other similar defects. The percentage of questionable rails per mile of track on the various divisions varies, but records accumulated on the New York Central lines show that the cars have detected an average of one fissured rail in every 19 miles of track; one split or crushed head or more or less similar defect every 10.7 miles; and a rail containing

a defect of some character every 7 miles. The concealed defects detected by the Sperry equipment are generally in the initial stage of development. The rails are, of course, replaced immediately by tested rails to insure against any possibility of installing questionable rails in tested track.

It can be readily appreciated that the new detector car was quite costly and that it involves considerable expense for operation and maintenance. However, these costs seem fully justified in view of the added safety and protection afforded and are in line with the general policy of the New York Central to promote maximum safety in rail transportation.

Full credit for the invention of the rail flaw detector is due to the late Dr. E. A. Sperry, but there is an interesting history back of the development of this equipment in which the New York Central played an important part. Many are, of course, familiar with the important work which the late Dr. P. H. Dudley performed for the New York Central, dating back to 1878, when he invented his track recorder, a car-mounted device with which he made literally thousands of miles of surveys of track conditions. This device told the tale of shortcomings of rails then in use and the general inadequacy of the track structure. It was through this device that a more scientific method of rail design was developed which led to the introduction of the first 5-in. 80-lb. rail in 1884. The second stage in rail improvement was the refinement in manufacture to keep pace with improved rail design, which brought about better methods of both physical and chemical testing to insure the proper grade of product. The 6-in. 100-lb. rail followed in due course of time and paved the way for modern power and heavier paying loads.





Above—A Close-Up View of the Rail Contact Brushes. Right—Looking Through the Rear of the Car Over the Detector Recording Table

The next studies of Dr. Dudley culminated in 1897 in the invention of the stremmatograph which was the first device for actually recording strains in the bases of rails under the moving loads of locomotives and equipment, and furnished the basic information for the laws of the relationship of moving loads, their distribution, and strains induced in the rails. Later on, more detailed studies were made of rail failures which were then becoming of increasing importance. The discovery of interior transverse fissures in open hearth rails in 1911 aroused the widest interest in rail defects, and focused the attention of the railroad world on this new and unexpected problem.

Years of intensive study followed, delving into the characteristics and possible causes of this hidden defect, and a vast amount of data was accumulated by various scientific bodies, railroad and rail mill laboratories, and other investigators. Efforts were first made to detect fissures in advance of the complete fracture of the rail. Portable mirrors were placed on standards and moved laboriously along the track by hand to disclose the tell-tale cracks of fissures underneath the head, the favorite place for them to break through the perifery of the rail. Advance development of fissures was thus essential for their detection.

Under the leadership of the late Dr. C. W. Burrows, the Bureau of Standards was also attempting to apply magnetic induction methods to the study of the internal unsoundness of rails, this method having been used for the internal exploration of other products. The New York Central became interested in this development, and, in 1916, at the suggestion of Dr. Dudley, a magnetic solenoid was built in exact conformity with the principles and designs developed by Dr. Burrows. Several hundred new and old rails, rolled under varying conditions of manufacture and with known track history, were completely explored by this device.

This work was still in progress when Dr. Sperry and Dr. Dudley met in 1921. Dr. Sperry had at that time perfected a track recorder which utilized a gyroscope and which, electrically and mechanically was a vast improvement over the device perfected by Dr. Dudley over 40 years before. Dr. Sperry's recorder was then undergoing test on the Santa Fe, and the meeting of the two men in 1921 was for mutual comparison of their respective designs of the same device. Incidentally, the whole problem of fissures in rails was discussed, including the magnetic testing work which the New York Central was then conducting.

As a result of the work on the Central, it became apparent that while the magnetic induction method furnished valuable evidence of the condition of the rail structure, was extremely accurate, and repeated results with the greatest of fidelity, it was super-sensitive. Mechanical injuries, such as gagging, spike maul blow marks and other physical defects, were as readily indicated as fissures or other important defects, making it almost impossible to distinguish one type of defect from another.

During one of several conversations between Dr. Dudley and Dr. Sperry in 1921 and later, the subject of the testing of steel mechanically was discussed, and Dr. Sperry suggested, after having given the matter considerable thought, that he believed it would be possible to employ electrical flux to detect interior ruptures in rail steel, and thus make it possible to differentiate between such defects and minor mechanical defects. To quote Dr. Sperry—"With electricity, a mere miss is as good as a mile. The most minute crevice, even though impossible to observe with a microscope, may be mole-

cules wide and if it is only a single molecule wide, the electrical flux coming up to it is stopped absolutely. To the flow of electricity, this minute crevice is as wide as a canyon. This means that the current, to this extent, is stopped completely and must pass around, encountering a definitely reduced section of the conductor at this point in the bar, and giving, therefore, a definitely sudden fall of electric protential." Furthermore, it was suggested that a device might be developed which could be mounted upon a car for passage over the track to search for defects in the rails without requiring the removal of the rails for such inspection.

These primary discussions led finally to the development of a machine by Dr. Sperry, which was installed in the plant of the Sperry Gyroscope Company in Brooklyn early in 1927. Samples of rail steel were furnished by the New York Central, and later by other roads, for use in testing the device and to aid in its practical development.

The experimental work in the laboratory proved to the satisfaction of everyone associated with this study that the basic principles employed were sound, and that with suitable equipment and co-ordinated testing apparatus, a machine could be developed to operate on railroad tracks at comparatively low speeds to locate flaws or irregularities in rails in service. As a result of this laboratory work, a contract was entered into between the American Railway Association and the Sperry Company on October 24, 1927, for the construction of a track car. Plans had already been made for such a car in the early part of the year, and actual construction was started in June. The car was ready for testing and trial just prior to January 1, 1928.

Railroad Co-operation Aided Development

The Sperry Company and the New York Central continued in close co-operation, and the New York Central arranged to set aside a track at Beacon, N. Y., for the initial trial tests of the car, so that the equipment could be carefully checked and such changes made in the apparatus as the trials might indicate to be necessary. The track was 650 ft. long and was laid with rails varying from 8 to 22 ft. in length, which had been removed from main-line service because of defects. This furnished the material best adapted for testing the equipment.

It had been anticipated that a relatively short time would be required in this testing before it would be possible to place the car in regular operation, but it was found that numerous changes had to be made in details of the apparatus during a period of more than nine months. This included the development of an entirely new method of detection. All of this work was done while the car was at Beacon, the New York Central co-operating closely with the Sperry Company and furnishing such facilities and assistance as were required to expedite the work.

Finally the car was considered to be in shape for a main-line test, and on September 13 and 14, 1928, trials were conducted in the presence of members of the Rail committee, Engineering division, A. R. A., who were made responsible for the acceptance of the car. Test runs were made north of Beacon on the high-speed, main-line tracks of the New York Central. The car was considered satisfactory for acceptance and was assigned to commercial testing in October, 1928, under the supervision of the American Railway Engineering Association. The first commercial run of the car was on the New York Central, and extended from Beacon to Albany, N. Y., and return. Following this, the car was tested on other roads throughout the country, and has been in successful operation ever since. Improvements were added to this equipment by the Sperry Company immediately after acceptance by the A. R. A., and other improvements have been incorporated in the car from time to time since.

N. Y. C. Large User of Early Equipment

Following the first months of use of the A. R. A. detector car, a considerable demand arose for the service of such equipment. As a result, the Sperry Company started building additional equipment in 1928 and developed a service organization to fulfill the need which had arisen. The New York Central was one of the early applicants for this service, having arranged for the use of one of the double Sperry units late in 1929. Actual testing was started at Albany on January 2, 1930, and subsequently a large mileage was covered by several of the Sperry cars on various parts of the system. Continuing the rail inspection in 1931, a total of more than 5,500 miles of tracks were covered. In this work, the main tracks between New York and Chicago were fully covered, the line from New York to Buffalo, N. Y. was tested at least twice, and a third test was made on about 200 miles of track.

In addition to this work, arrangements were made between the Sperry Company and the New York Central, in June, 1930, for the installation in track at Fonda, N. Y. of a number of the rails which had been removed from service after fissures had been detected in them by the car. Once each week representatives of the Sperry Company made hand checks of the fissures with portable apparatus to determine their rate of growth. This work was carried on for about ten months, when a second installation of fissure rails was made at Beacon, N. Y., in June, 1931, where the rails were subjected to different conditions of traffic and speed.

The Sperry Company and the New York Central continued their co-operation in research and test work with the result that early in 1929, arrangements were made with the Sperry Company for the single-unit, self-propelled, rail-flaw detector car described above.

The new car was to differ in so many ways from anything previously constructed that a large amount of study was necessary to work out the details of its design. The first step in its construction, which was started in April, 1930, was the building of the car body and the gas-electric power plant for the propulsion of the car, which was done under the direction of the J. G. Brill Company. The second step involved the fitting up of the car for the purpose intended, which was done in the West Albany shops of the New York Central. When this work was completed, the car was shipped to the Sperry Company at Brooklyn, where the detector equipment was installed.

Following an acceptance test over 50 miles of selected track which was started on August 28, 1931, and indicated that the equipment functioned with a high degree of accuracy, the new car was assigned to the jurisdiction of Arthur Knapp, inspecting engineer, rails, wheels and structural steel, New York Central Lines. Regular testing commenced on September 29, 1931, and the car has been in continuous service since, having completed testing on the westbound track between Albany and Chicago and on the eastbound track between Chicago and Cleveland, Ohio. It is planned first to make a complete survey of the main-line high-speed tracks between New York and Chicago, following which the car will be available for use generally on the extensive territory of the entire New York Central lines.

How One Railroad Has Water Supply

The Zeolite Treating and Pumping Plant at Addis, La.

During the last 10 years the Texas & Pacific has carried out an extensive program for the modernization and expansion of its water facilities. In this period the number of water-treating plants has been increased from 3 to 25, while in the last four years the number of reservoirs has been increased from 5 to 22, pumping and other water station equipment has been modernized and many miles of pipe line have been laid.

PRESSED as well as aided by the growth of traffic in the period from 1920 to 1930, caused principally by the oil boom in Texas and the concurrent improving business conditions, the Texas & Pacific has made great strides in the improvement of every phase of its physical property. In addition to heavier and better power, stronger roadbed, and terminal facilities, special attention was given the water facilities because of the varied and severe water problems encountered along the line, and as a result marked improvements have been made. Ten years ago, or in 1922, there were only 3 water treating plants on the 2,000 miles of this road, whereas since that time, treatment has been provided at 22 additional points, and practically every other water station on the main line has been modernized or rebuilt.

Water Problems Are Varied

On the T. & P., which extends from New Orleans, La., to El Paso, Tex., the water supply problem divides itself quite naturally into four main parts according to the rainfall and other local conditions along the line, but so varied are the conditions, in even the same general territory, that practically every water station on the road presents a distinct problem requiring special study. The main districts of the road from the standpoint of water conditions are Louisiana, considered from New Orleans to some distance beyond Shreveport; eastern Texas, from Texarkana to Dallas; central Texas, from Dallas to Sweetwater; and western Texas, from Sweetwater west to El Paso. Over this territory, from New Orleans to El Paso, a distance of about 1,200 miles, the annual rainfall varies quite uniformly from about 70 in. in Louisiana, to 35 to 40 in. in eastern Texas, 15 to 35 in. in central Texas, and from little or no rainfall to 15 in. in western Texas.

Until about 1922 water of fair quality was plentiful in the Louisiana territory, and the road had little difficulty in securing satisfactory supplies from streams and bayous along its line. In the two or three years following 1922, however, there was a drought which, combined with increased locomotive consumption, drew the available waters in many of the smaller bayous to such low levels that they became contaminated with the highly acid seepage water from swamps. As a result of this change in conditions, which produced some of the poorest locomotive water on the road and caused extensive destruction of locomotive flues, a number of shallow wells were drilled, but many of these also soon became contaminated. In recent years deep wells have been put down at a number of points, city supplies have been tapped at several others, and at Vacherie, La., water has been taken from the Mississippi river. This latter source of supply could have been drawn on at a number of points, but in practically all cases to have done so would have involved long and expensive pipe lines with settling basins or filters. Up the Red River valley, from Cypress, La., to Shreveport, large bayous or lakes had to be relied on for supplies, and even here the water was hard, containing calcium and magnesium carbonate and calcium sulphate, and had to be treated.

Widely Varied Conditions in Texas

In eastern Texas, as far west as Dallas, shallow wells were depended upon largely for water prior to 1920, although both the quantity and quality of water from this source were quite unsatisfactory. A few reservoirs had been built to impound storm flows and this type of supply promised to be the solution of the problem elsewhere in this territory, as deep wells produced most unsatisfactory waters containing large amounts of sodium chloride and sodium bicarbonate. The same situation with regard to shallow well waters prevailed quite generally in central and western Texas, but with the exception of a few surface supplies and deep wells, the shallow wells were depended upon to meet the water requirements.

After 1925, there was a noticeable increase in the water consumption on the lines in Texas, and, with the advent of the oil boom in western Texas in 1926, the water demand increased approximately 100 per cent in the territory west of Toyah and approximately 300 per cent throughout the territory east of Toyah, all within a year's time. With this largely increased demand, the old shallow wells soon became totally inadequate and a most intensive search was inaugurated for new sources of supply. Immediately a large number of drilling rigs were put to work hunting good water and many deep wells were put down.

At many of the old water points the supplies became exhausted and water had to be hauled from other points, while at still other places treatment had to be suspended because of insufficient water to flush out the treating tanks,

Improved its

a situation which caused extensive damage to locomotive boilers until it was corrected. At Loraine, Texas, the normal water consumption had been approximately 60,000 gal. a day, but when the rush came on, five artesian wells were put down and provided a daily capacity of approximately 500,000 gal. A large part of this water was hauled 23 miles east to Sweetwater and 43 miles west to Big Spring to satisfy depleted supplies at these points.

Deep wells saved the day at many points in central and western Texas during the peak of the boom, but the supplies gained were not dependable and one by one the wells gave out so that new wells had to be drilled constantly to keep up with the demand. The evident solution of the problem in Texas lay in the construction of reservoirs where suitable watersheds and reservoir sites were available, and, recognizing this, a number of reservoirs or artificial lakes have been constructed in recent years. In the 150 miles between Big Spring and Toyah there are no sites for reservoirs and the road must rely on moderately deep wells. Deep wells in this territory produce salt water.

In western Texas, some reservoir sites were found and several reservoirs were built, but in this territory the greatest of care has to be exercised, not only in the selection of sites, but also in their preparation because of underlying deposits of gypsum and gravel which will not hold water. Only natural sites are being developed, therefore, because to break the watertight surface formation of clay in developing a site would allow the water to filter out through the underlying porous strata. At the present time, very few shallow well stations are still in service in the three divisions of Texas.

Extensive Reservoir Development

Reservoir development on the Texas & Pacific has been one of the outstanding phases of its water service improvements in recent years, although water treatment has received a large amount of attention, together with extensive improvements in pumps and pumping-station equipment. The improvements made have been quite general over the entire road, but with the development of larger tenders and longer engine runs, major attention has been given to the building up of the water facilities at terminal points. At several of these, quite elaborate and interesting facilities have been provided, as for example at Toyah, where an entirely new plant, with a 37½-mile pipe line, taps a spring in Davis mountain, and at

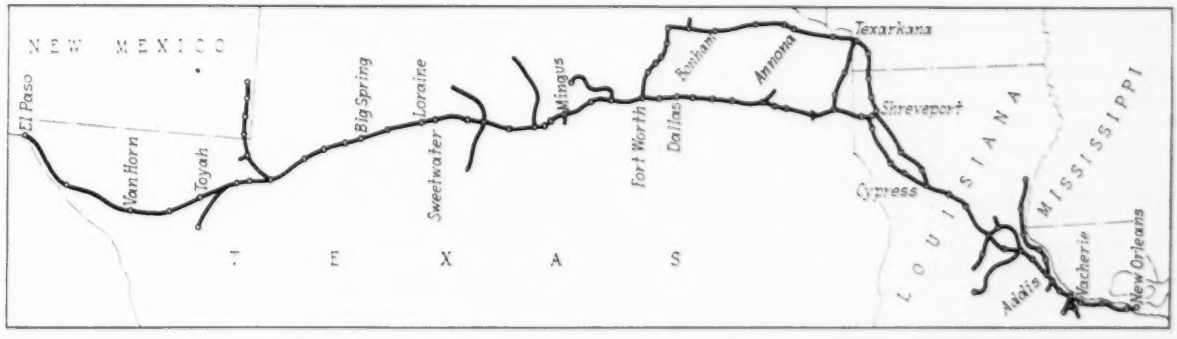
The Lime-Soda Treating and Pumping Plant at East Dallas, Tex.

Vacherie, La., where new pumping, storage and treating facilities, with approximately a mile of 10-in. supply line, provide water from the Mississippi river.

At the present time there are 22 reservoirs on the road, 17 of which have been developed within the last four years. These reservoirs vary in size with the local demand for water and also with the rainfall at the different points, from the smallest covering approximately 10 acres, with a capacity of 21,000,000 gal., to the largest covering 60 acres and having a capacity of 630,000,000 gal. The latter is at Levinson, Tex., in the foothills between the Davis and Guadaloupe mountains, where the annual rainfall is from 15 to 20 in. This reservoir, which was enlarged in 1929, is fed from a natural drainage area of approximately 120 sq. mi. It was formed by building a dam, 800 ft. long and 40 ft. high, across a comparatively narrow valley, and constructing a spillway at some distance from the dam, in the form of a relatively low concrete wall across a saddle between two hills. The second largest reservoir on the line is at Mingus, Tex., with 315,000,000 gal. capacity, while the third largest is at Bonham, Tex., with a capacity of 200,000,000 gal.

The dams built in connection with all of the reservoirs are of earth and of practically the same general construction throughout. Great care was taken to key the dams to the foundation, this being done usually by digging a six-foot trench, three feet wide, along the longitudinal center line of the dam site, and filling this with concrete, which is then carried up from four to six feet above the natural ground level, depending upon the height of the dam. A clay core, usually 12 ft. wide, is built directly over the key, and the dam slopes are made 3 to 1 on the water side and 2 to 1 on the dry side. The water face of the dam is usually paved with native stone rip-rap or a four-inch concrete slab.

Two spillways are provided at each reservoir, one of the well type with the overflow level seven feet below the

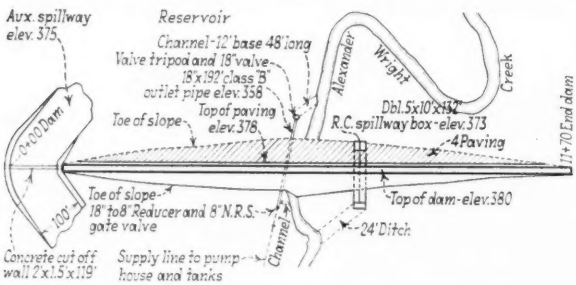


Map of the Texas & Pacific Showing the Location of Water Supply Stations on the System

crest of the dam and with a pipe or box passing through the base, and the other of the open channel or weir type, constructed of concrete with the crest five feet below the top of the dam. In addition to these overflow outlets, an emergency drain, usually in the form of a large diameter pipe, is provided through the base of the dam, this precaution being required by Texas law.

New Pumping and Treating Equipment

The pumping equipment in service on the Texas & Pacific has undergone as extensive changes in recent years as the sources of supply and, whereas practically all pumping was done by steam power or windmills 10



Details of the Reservoir Dam Near Annona, Tex., Which Is Typical of Many of the Dams Constructed on the Texas & Pacific

or 15 years ago, 56 of the 63 stations requiring pumping equipment, are now served, either in whole or in part, by oil engine or electric motor-driven pumping equipment. Wherever possible, automatic electric plants, controlled by float switches, are being installed, so that plant attention can be reduced to a minimum.

Deepwell turbine pumps have been added to the water supply equipment at all stations where practical and have been found to be readily adaptable for reservoir supplies and automatic stations. When used in connection with reservoirs, a small pump house, usually 10 ft. by 10 ft., is erected on four piles at a point in the reservoir where the water is deepest, and the pump is then set with its impellers about three feet above the bottom. In this way, practically the entire supply of the lake is available and the necessity for an expensive concrete pit is eliminated as the pump has the assurance of a constant prime. With a small derrick erected over the pump house, the entire pump and drop line can be easily lifted from the reservoir when desired for examination. The pump is usually less than 30 ft. below the surface of the water.

This particular type of installation has proved very satisfactory at many points on the road. At one location where it was desired to erect such a station, but where electricity was not available for power, a larger house with a concrete deck and pump foundation, was built on piling and was fitted with a 30-hp. marine-type Diesel engine, directly connected to the pump head through a flexible coupling. This installation has been operated with entirely satisfactory results.

Since the first installation of automatic pumping equipment on the Texas & Pacific about five years ago, automatically operated plants have been installed at 25 points. Largely as a result of this and other improvements, the water service forces on the different divisions have been reduced to a supervisor and three pump repairmen. Under ordinary circumstances, the automatic plants are visited only once a week for inspection, and only about once a month for oiling.

Nine years ago there were only three points at which water was treated on the road, whereas today some form of treatment is provided at 25 points. The character and extent of the treatment vary widely with character of the water over the line, the principal forms including lime, lime-soda ash, coagulants, zeolite, filters and chlorination. Lime or lime-soda ash is employed most widely on the road, there being 18 plants of this type. At many of these plants sodium aluminate is added as a coagulant. Plans are under way at the present time for the provision of ten new wayside plants for treating with sodium aluminate. With the completion of these, it is said that practically the entire main line of the road will be freed of objectionable boiler waters.

Storage tanks have also come within the scope of the water service improvements and, whereas the older tanks were largely of wood or corrugated iron and relatively small, rarely exceeding 50,000 gal. capacity, recent years have seen these old tanks replaced largely by elevated steel tanks with either hemispherical or conical bottoms and ranging in capacity from 50,000 gal. to 300,000 gal. Most of the tanks, however, are of either 100,000 gal. or 150,000 gal. capacity. At the present time there are 50 steel tanks on the road, 37 of which have been erected in the last 3½ years.

With so many entirely new or rebuilt and equipped water stations on the Texas & Pacific as a result of its water service improvement program, it is impossible to include here even a most general description of the work at each point. In the following, therefore, attempt is made only to describe briefly the improvements which have been made at a few of the most important watering points within the last two or three years.

The Reservoir Pumping Plant at Rodey, Tex., Served by a Deep Well Turbine Pump as Used at Many Other Reservoirs

Long Pipe Line to Toyah

Some of the most interesting of recent improvements have been carried out at Toyah, Tex., a terminal, which lies in an arid region surrounded on three sides by mountain ridges about 30 miles distant. For many years water has been the greatest problem at Toyah. Wells had been sunk in and around the town in all directions and for many miles, but all were of short life and small capacity and produced hard water. An artesian water is obtainable at a depth of 750 ft., but this water cannot be used on account of its high sulphate content. A reservoir was built a number of years ago, but evaporation and seepage exceeded the inflow, and therefore very little of its water was ever utilized for railway purposes.

The latest solution of the problem at this point was the development of a spring which was found high in the Davis mountains, 37 miles from Toyah. From a study of this spring, extending over a number of years, it was learned that, in spite of a considerable seasonal fluctuation, it had an average daily output of 1,000,000 gal. The minimum tested output was 700,000 gal. and the maximum 1,500,000 gal. Fortunately the water is soft and uncontaminated.

With the thought of ending its water troubles at Toyah, the railway appropriated $650,000 to purchase, store and pipe the water to town. A maximum flow of 1,000,000 gal. a day was used as a basis of computation, which is approximately 2½ times the average demand at present. The pipe line connecting the spring and the town has a measured length of 37½ miles and a drop of 1,065 ft., and was laid throughout with its grade line below the hydraulic gradient. The line is constructed of 8-in., 10-in. and 12-in. centrifugally-cast iron pipe, with all joints caulked with dry Portland cement.

A General View of the New Dam and Reservoir at Toyah, Tex., Under Construction

Provision for Safeguarding the Line

Two surge tanks were introduced into the line to relieve excess pressures, these being 11-ft. by 16-ft. cylindrical steel tanks with roofs, with the inlet and outlet through the bottom in each case. The inlet rises to within a short distance of the top of the tank, where it is capped with a 10-in. angle float valve. Below this valve there are two other float valves, one ¾ in. and the other 1½ in., set on nipples screwed into the main pipe. The floats for the valves are so set that as the drain on the tank slows up and the tank becomes filled, the valves close off in order inversely to their size. For additional safety a float valve is set just outside the tank in the feed line, with the float set low inside the tank and connected to the valve through a series of levers. If a break should occur in the line below the tank, this valve cuts off the flow into the tank automatically. Automatic air valves are provided at all summits in the line and pressure relief valves are located just ahead of the surge tanks. Gate valves are also located at strategic points along the line.

Where creeks and dry arroyos were encountered, the pipe was laid under ground and either anchored with concrete blocks and cable or by means of concrete slabs laid over the pipe. This system was adopted instead of carrying the line over such waterways on bridges or pedestals, because the drainage in this section of the country, which is rocky with a high percentage of run-off, is both spasmodic and rapid. Heavy storms put torrents in the creeks, otherwise dry or practically dry, which are of such force that they sweep everything before them.

Near Toyah an elevated settling tank was erected on a hill. This tank, which has an open top and a conical bottom to insure rapid and thorough flushing, has a capacity of 190,000 gal. The water is introduced over the top and into a watertight conical downcomer, through which it moves downward and then up around the outside to a pipe outlet set 18 in. below the top of the tank. A coagulant is introduced at the top of the tank to clear the water when rainfall has made it turbid, the coagulant being pumped from below by means of a water motor set in the raw-water line. The settling period is eight hours, which gives the tank a capacity of about 500,000 gal. a day, the present maximum consumption. If the demand of Toyah should increase, it is planned to erect another settling tank.

After passing through the settling tank, the water flows to Toyah where the line is divided into two smaller lines, one extending to a 100,000-gal. elevated steel storage tank from which the water columns are supplied, and the other carrying the water through rapid sand filters, thence through chlorination, and then into an elevated tank from which potable water mains carry it to the depot, hotel, section houses, and other company buildings. Both of the tanks at Toyah are equipped with float valves which regulate the inflow of the water automatically.

Just below the hillside settling tank, a 500,000-gal. storage tank is tied into the line. When the tanks at Toyah are filled, the water flows into this larger storage tank. A pressure-regulated valve located in the supply line just ahead of the treating tank, regulates the flow into the 500,000-gal. tank and is adjusted to close when this tank is filled to capacity. Thus the line works automatically throughout.

Spring Flow Impounded

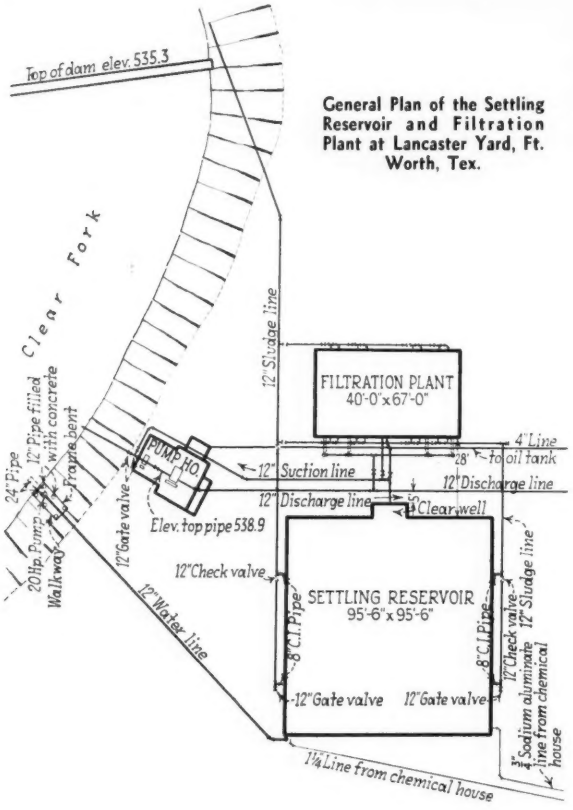
In order to equalize the seasonal flow of the spring, an earth dam is being constructed in the hills just below it, which will impound approximately 85,000,000 gal. of water. The dam is 40 ft. high in midstream and 350 ft. long. In order to secure the dam against sliding, a trench was dug throughout its length, in the solid rock, and a concrete key was poured. This key rises to a height of six feet and is surmounted by the clay core of the dam proper. The core is 12 ft. wide and the dam is sloped 3 to 1 on the pond side, with a rip-rap face, and 2 to 1 on the dry side. The spillway is 100 ft. wide and was excavated in solid rock at the west end of the dam. Concrete beams carry all pipes through the base of the dam and across the core trench, and thereby avoid any possibility of settlement at the joints.

At Vacherie, La., about 45 miles from New Orleans, entirely new water facilities have been provided at a

cost of approximately $50,000, to replace two water stations at Edgard, to the east, and St. James, to the west, where unsatisfactory supplies were being secured from shallow wells. Throughout all of this general territory, well water is salty and surface supplies are mostly acid, which led to the decision to pipe water from the Mississippi river.

In the layout provided, which extends over about a mile from the river to the track water columns, a circular concrete pump house was constructed on the batture of the river levee, and was so designed that the inside bottom floor was only 10 ft. above low water level. A door at the top of the house is at about the elevation of the top of the levee. In this way the pumping equipment is protected in times of high water, and yet is so located that it can always pick up a prime in times of low water.

A triplex pump is set in the bottom of the house and is provided with an 8-in. suction line extending into the river and supported on posts. A 10-hp. oil engine, direct-connected to the pump head, which, in turn, is joined to the triplex pump through extension rods, furnishes power to lift the water over the levee where it passes through a water engine and then into a 190,000-gal. elevated steel lime-soda treating and settling tank. This tank is cylindrical and has a conical bottom to insure rapid and thorough flushing. Washout of the tank is through an eight-inch pipe, which carries the sludge over the levee and back into the river below the pump house.



General Plan of the Settling Reservoir and Filtration Plant at Lancaster Yard, Ft. Worth, Tex.

After the water has passed through the new treating tank it flows by gravity through a 10-in. cast iron pipe line, about a mile long, to a 100,000-gal. elevated steel service tank located on the right-of-way at Vacherie, from which connection is made through a 12-in. line to a water column located between the two main line tracks.

At Fort Worth, Tex., river water is also used for locomotive supply, a pumping station at Clear Fork, which takes water from the Clear fork of the Trinity river, supplying both Fort Worth proper and Lancaster yard. The supply at this point has always been adequate to meet the daily demand of approximately 1,250,000 gal., but the raw water has a hardness varying from 5 to 20 grains, which makes it unsatisfactory. To overcome this hardness, lime-soda ash treatment was provided, with an effective settling basin, which lowers the water to a 0.9-grain hardness.

The settling basin is of concrete construction, 100 ft. long by 100 ft. wide by 15 ft. deep, and is divided into four equal parts, each of which is further divided into four equal parts by baffle walls. The river water is first pumped into an open concrete race where the lime and soda ash are introduced, and then passes through the sedimentation basin providing a retention period of 16 hours. From this basin it passes to a rapid sand filter, which, like the settling basin, has a capacity of 1,200 gal. per min.

The water is raised from the creek by an electric turbine, and, after passing through the treating plant, is elevated into two 300,000-gal. service tanks, one in Lancaster yard and the other in up-town Ft. Worth, by a centrifugal pump driven by a 75-hp. semi-Diesel engine. The treating plant is located some distance from the track, but the chemical house is adjacent to the track where the chemicals can be unloaded directly into it from cars. As prepared in a chemical vat, the chemicals are pumped to the treating plant. The sodium aluminate, which is used as the coagulant in the settling tank, flows by gravity and is controlled automatically by an electric valve. All chemical and mixing pumps, as well as the water pump discharging into the treating tank, are electrically driven and are controlled by float switches.

Oil Engines Replace Steam at Van Horn

At Van Horn, Tex., about 125 miles east of El Paso, where the rainfall averages only 12½ in. per annum, the water supply problem resolved itself into one of deep wells as the only available source of supply, and, fortunately, a soft water is obtainable from this source. Until recently, however, steam pumping equipment was used exclusively at this point, which was inadequate and uneconomical. Now, semi- and full Diesel engines and deep well pumps are used.

There are four wells at Van Horn with a monthly average output of 6,000,000 gal. These wells are 600 ft. deep, with the water sand about 500 ft. below the surface. Two of the wells meet the demand at this point and have been equipped with new deep well pumps, with the working barrels set about 520 ft. below the surface. The other two wells are still equipped with steam heads, which, with the old boiler plant, are held for use in emergency. The new pumps are belt-driven, one by a 37½-hp. semi-Diesel engine and the other by a 40-hp. full Diesel engine. Each pump delivers 110 gal. per min. The installation of the equipment is such that when either pump must be pulled, the drive belt of its driving engine is slipped off and a shorter belt is substituted, which is used to operate a hoist. The hoist is a permanent fixture at each well and lies between the engine and the pump. An emergency fuel-oil station is also maintained at this point and in one of the installations, an extension shaft is attached to the engine, which, in turn, is belted to a triplex fuel-oil pump set in a 12-ft. pit. The fuel oil for the operation of the locomotives is unloaded directly from tank cars into an outside sump. From the sump it flows to the pump by gravity and is then raised into a 50,000-gal. elevated storage tank. The pump has a capacity of 12,000 gal. per hour.

With many of the water service improvements on the

(Continued on page 277)

Why Not Use Creosoted Piles For Building Foundations?*

Condition of treated wood under footings of Illinois Central structures affords a definite answer to this question

The Passenger Station of the Illinois Central at Baton Rouge, La., Which is Supported on Creosoted Piling.

By F. R. JUDD
Engineer of Buildings, Illinois Central

THE USE of creosoted piling for building foundations on the Illinois Central is the natural outgrowth of its use for bridge work. The records show that the first creosoted piling was used in 1904 in connection with the development of creosoted ballast-deck bridges. These records also show that creosoted piles were first used for bridge foundations in 1911 and for the foundations of building structures in the same year. For the purpose of this paper, the term "building structure" is used in the broader sense defined in rulings of the Interstate Commerce Commission as including, in addition to buildings proper, such structures as craneways, turntable and cinder pits, concrete and brick chimneys and similar structures.

First Used in 1911

In accordance with this interpretation, the records of the Illinois Central indicate that a creosoted pile foundation for building purposes was first used under the center of a balanced turntable at Champaign, Ill., in 1911. Examination of the foundation on October 30, 1931, made by digging down and exposing some of the piles, disclosed the following information: The general appearance was good, in fact, the piles looked as if they had just been driven. Borings from these piles showed that both the untreated heart and the outer treated portion were apparently as sound as new wood. The borings also showed a treatment penetration of 2½ in. and gave off a strong odor of creosote. When placed in a paper container, these borings gave off sufficient oil to soak into and discolor the container.

The foundation soil in this instance is a sandy clay, subject to alternate wet and dry conditions, depending upon the rainfall. At the time of inspection, these piles had been in the ground 21 years with apparently no deterioration, indicating that a creosoted pile thoroughly surrounded by soil and covered with a concrete cap to prevent volatilization of the oil, will have a long, if not a permanent, life.

Train sheds are another type of structure under which creosoted piles have been used successfully. The butterfly type of shed is used extensively, especially in connection with track-elevation work. Where this shed is of reinforced concrete or steel construction, it is necessary to use piles in the sand fill or to carry the substructure down to the original ground, which is usually very costly. The logical support is, therefore, a pile foundation, and as the filling is subject to alternate wetting and drying, the use of treated piles is desirable from the standpoint of economy.

One of the earliest sheds of this kind on the Illinois Central was built in connection with track elevation work at Memphis, Tenn., in 1914. There is a downspout at every alternate post of this structure, but as no sewers are provided the water from the downspout is turned into the sand fill under the platform. Naturally this produces a very wet condition in the vicinity of these foundations for short periods of time; yet, the exposure of one of these foundations in November, 1931, showed that these piles are apparently in sound condition after 17 years of service.

Coaling stations are another type of structure under which creosoted piles can be used to advantage. The arrangement of column spacing is such that the interior columns are usually carried on the sidewalls, or on pilasters in the sidewalls, of the bucket pit, while the exterior columns are carried on isolated piers of shallow depth, supported on creosoted piling in order to avoid the expense of carrying these isolated piers down to a natural foundation, or below the fixed water line where untreated piling could be used. The depth of the center portion of the foundation is often such that a good natural foundation is obtained or the permanent water line is reached so that untreated piling can be used for this portion of the substructure. In other cases, the variation of water line may be such that creosoted piling will be required throughout the entire foundation.

An example of this type is a 300-ton coaling station built in 1917 in connection with an engine terminal. The site for this coaling station is adjacent to the Mississippi river where there is an average variation of 40 ft. between high and low water. Since a satisfactory natural foundation could not be obtained as the general soil was a silt deposit, it was necessary to resort to piling. The lowest point of the foundation was 20 ft. above low water line so that creosoted piling was used throughout. It will

* Abstracted from a paper presented before the annual meeting of the American Wood-Preservers' Association, at St. Louis, Mo., on January 27.

readily be seen that a considerable saving was made over what the cost would have been if the foundation had been carried to low water to permit the use of untreated piling.

On December 12, two piles were exposed under one of the isolated piers. From outside appearances these piles appeared to be in good condition and gave off a strong odor of creosote. Borings showed that the creosote had penetrated 2 in. into one pile and 1¾ in. into the other, leaving an untreated core approximately 10 in. in diameter. Both the treated and untreated timber were found to be in sound condition. The treated borings not only gave off a strong odor of creosote, but the heart borings gave off a very marked odor of resin, indicating that the creosoted shell was giving protection to the center.

Station Buildings

Our passenger station at Baton Rouge, La., affords a good example of the use of creosoted piling for building foundations. This structure is approximately 40 ft. wide and 400 ft. long and requires a good foundation to prevent cracks in the plaster and brick work. The station is immediately back of and adjacent to the levee which confines the Mississippi river during flood stages; in fact, some of the passenger station tracks are on the land side slope of the levee. The variation between high and low water at this point is approximately the same as at the coaling station and the foundation soil is very unstable, heavy trains passing or pulling into or out of the station causing considerable vibration. This station was built in 1922. No examination has been made of these piles, but the fact that, in spite of the vibration the brickwork and plaster are still in excellent condition, is good evidence that the use of piling was justified. The passenger station was one of a group of buildings which included a freight station 41 ft. wide by 524 ft. long, 200 ft. of which is two stories high; a power house with a brick stack, and a utility building, all being carried on creosoted piling.

A number of concrete and brick chimneys have been supported on creosoted pile foundations, including a concrete chimney 150 ft. high at Fulton, Ky., which was built in 1919.

This foundation was examined on November 11, 1931. An extract from the inspector's notes reads as follows:

Excavation to piling about 12 ft. deep in clay.

Practically no water encountered.

Depth of pile exposed below concrete cap, 2½ ft.

Number of piling exposed—2.

Piling wiped off thoroughly and found to be in good condition.

Borings showed the depth of treatment in one pile of approximately 4 in., with an untreated core of 4 in.

The borings of the other pile indicated a depth of treatment of approximately 5 in., with an untreated core of approximately 2 in.

Both the untreated and treated borings indicated sound timber, with the treated borings giving off a strong odor of creosote.

Track Scales

Track scales of both knife edge and plate fulcrum construction are another type of structure which has been carried successfully on creosoted pile foundations. It is necessary that the foundation be stable and level, as otherwise there is a constant source of expense in maintaining the scale in a condition of accuracy. The plate fulcrum type has been used on the Illinois Central in the operation of gravity classification yards, in which case the scale is placed in the hump track a short distance below the summit of the hump on the side descending toward the classification yard.

Some of these installations have cost as much as $90,000, an amount justifying foundations, for otherwise the money is spent to no avail. Track scales and mechanical humps have to be placed high enough so that after the passage of a car there is sufficient grade below the scale to carry it the full length of a long classification track. The foundations are therefore considerably above the natural ground or line of permanent moisture in the surrounding soil so that the use of creosoted or concrete piling must be resorted to in order to avoid the large expense which would be incurred if the concrete foundations had to be carried down to the natural ground.

Building Ordinances

The structures to which reference has just been made as having been successfully supported on creosoted pile foundations include turntables, train sheds, coaling stations, passenger and freight stations, concrete and brick chimneys, track scales and mechanical humps. No mention has been made of multiple story buildings. This is due to the fact that buildings of this type are usually constructed within city limits which have building codes. Most of these codes were written prior to the use of creosoted piling and no recognition is given to this type of foundation. For instance, the code in the city of Chicago requires all timber piling to be cut off one foot below city datum, or lake level, irrespective of whether it is treated or untreated; therefore, under the operation of the present ordinance no saving can be made by the use of creosoted piling, and untreated piling are always used for timber pile foundations. If the ordinance differentiated between treated and untreated piling, a reduced depth of concrete foundation could be used in some types of buildings, which would give a net reduction in the entire cost of the work. This, of course, would not apply to buildings with basements, which would bring the cut-off of the piles below the low water line, or to tall buildings where the height and consequent loads would probably justify the use of concrete caissons or concrete piles.

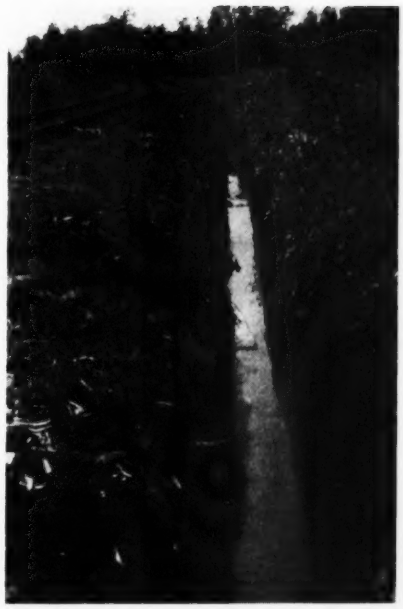
Of twelve ordinances for a like number of cities along the lines of the Illinois Central where structures have been built within the city limits, only one, namely, New Orleans, makes any specific provision for the use of creosoted piling. This ordinance requires that where untreated piles are used, the cut-off must not be less than eight feet below the curb to insure constant moisture in all parts, and in the vicinity of sewers must be below the bottom of the invert. For treated piles, the cut-off shall be below the ground surface.

So far these remarks have been confined exclusively to the use of creosoted pile foundations and no mention has been made of crib foundations of creosoted material. This is due to economic conditions along the lines of the Illinois Central which seldom warrant the use of crib foundations for building structures. It must be borne in mind that this comparison applies to Illinois Central experience and should not be applied in cases where concrete materials are not readily available.

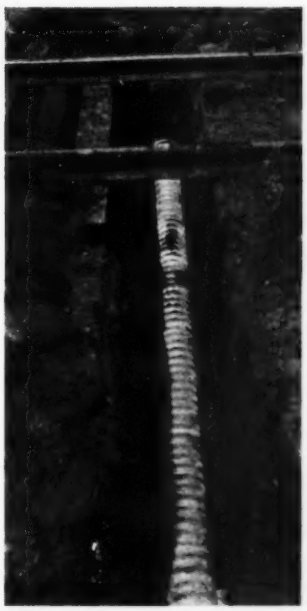
In this connection I will cite an experience that we had with turntable pits. At one time it was the practice where it was thought that the location or the life of the table would not justify concrete, to use a creosoted timber curb wall supported on a creosoted crib foundation, but conditions changed so fast on the railroad that invariably it was necessary to replace the table with one of longer span before the life of the creosoted material was obtained. In a few instances we were able to reuse the material where the tables being taken out could be shipped together with the creosoted material and put in at some other point. Where this could not be done the timbers for the cribbing, being in such short lengths and those for the curb wall being cut to a special radius, could not be used to advantage again.

Drainage System Pays Return of 15 Per Cent

Perforated pipe installation results in reduction in expenditures for maintenance and permits faster schedules



Trench for One of the Longitudinal Pipe Lines



Most of the Laterals Were Placed in Open Trenches

Rock Was Encountered in Some of the Trenches

THE Chicago, St. Paul, Minneapolis & Omaha, a part of the North Western system, found it necessary to improve track conditions on its main line near Rockmont, Wis., 20 miles southeast of Duluth, Minn., in accordance with a program to speed up service between Chicago and Duluth. The primary need was for the better drainage of about three miles of track across gently rolling country, the soil of which consists for the most part of a red, mineral-bearing clay. This material is highly impervious and flows readily when wet.

Practically the entire three miles was affected by poor drainage to a varying extent. However, the principal difficulties were encountered in four shallow cuts, ranging from 600 ft. to 2,000 ft. in length. The remainder of this section of track, located on embankments of various heights up to 20 ft., was not so seriously affected.

This part of the line had given trouble since its construction about 1882, the difficulties increasing since 1918 at a much faster rate, following the introduction of Mikado locomotives and an increase in train loads. Since that date maintenance charges had increased until at the time of this installation the excess charges on these three miles absorbed more than three-quarters of the allotment for the entire section. This is illustrated in the excess maintenance chart, which was developed by deducting from the number of man-hours allotted each year for the entire section of six miles, the amount of time spent on each soft spot. The remaining money was then distributed equally over the entire section as the cost of maintaining normal track. This chart does not include any estimate of the excess cost of operation due to slow orders or extra track material required to replace bent rail, cut ties, etc., but in the final analysis these charges should also be considered.

A slow order limiting speeds to 20 miles per hour was in force on this track during the rainy season from May 1 to August 1. During the cold weather this slow order was not required as the temperatures are such that the subgrade freezes solid, but owing to the uneven distribution of the water impounded under the track, freezing resulted in irregular heaving which called for considerable shimming. In an effort to improve track conditions, the railroad widened the side ditches through the cuts with a Jordan ditcher and constructed a berm ditch on the west side of the track. These operations, however, had not been successful in removing the water from under the track.

The unstable conditions were due to the fact that in the presence of water the soil under the track quickly softened and permitted the ballast to be forced

down into it, thus forming pockets for impounding water. These pockets were found to vary from four to seven feet in depth. Therefore, relief by ditching, even if practical, was considered to be prohibitive in cost.

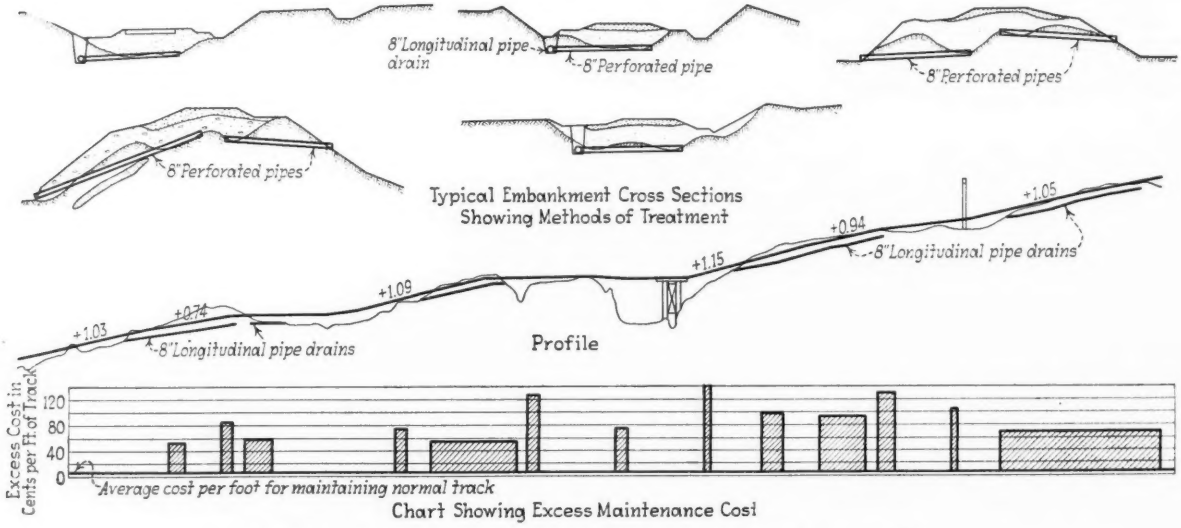
A Careful Survey of the Site

In October, 1930, a complete investigation was made of this troublesome piece of track. It was necessary to drill numerous test holes to determine the character of the subgrade and the depth and extent of the pockets. After this information was obtained, a drainage system was designed that would remove the impounded water and stabilize the roadbed. The drawings show longitudinal profiles of the track and of the longitudinal drain, and typical cross sections of the roadbed and the location of lateral drains. The extremely soft condition of the material found in the subgrade clearly indicated the necessity for the use of a drain pipe that could be fastened together in one continuous line, thus forming a system that would continue to function as a complete unit under the most severe conditions of loading that might be encountered.

The installation consisted of five principal parts. Four of those were complete units, each draining one of the cuts. These units are made up of an 8-in. unperforated corrugated pipe longitudinal drain, into which 8-in. perforated laterals were connected by means of corrugated tees. The fifth unit consists of several groups of 8-in. perforated laterals draining the various pockets in the drainage. At the time of the actual installation, the depth of all pockets was carefully checked and the drains were installed where they would produce the maximum effect.

A careful study of track conditions six months after the completion of the work indicated that the expenditure made was fully justified. It is estimated that the annual saving in maintenance will approximate 15 per cent of the first cost of the installation. Slow orders have been removed and track conditions are normal for the first time in many years. In addition, other savings have been made possible, such as those resulting from a shortening of train schedules.

The System Discharges Heavily After Rains



A Profile and Typical Cross-Sections of the Location, and an Excess Expenditure Chart

fills. In each of the longitudinal drains, corrugated catch basins were installed at intervals of about 500 ft. for collecting sediment. All longitudinal drains and the laterals for draining the shallow pockets were installed by the open-trench method. Where these operations would have interfered with traffic, the laterals were installed by means of a specially developed boring machine which obviated any work at the track level.

Design Subject to Modifications

The design of the drainage system was adapted to the conditions developed by the survey, with reasonable provision for the possible future development of other soft spots. It was evident from the preliminary investigation that an arbitrary determination of either the depth or spacing of laterals would not have provided complete

The investigation, plans, and installation were made by The Drainage Engineering Company, a corporation affiliated with the Ingot Iron Railway Products Company, which in turn is a subsidiary of the Armco Culvert Manufacturers Association. The project was under the general supervision of H. E. Barlow, chief engineer of the C., St. P., M. & O., and T. Johnson, assistant engineer, was in responsible charge of the work for the railroad.

SPRING WORK. In preparation for its spring maintenance of way program, the Delaware, Lackawanna & Western has placed orders for a considerable quantity of track tools and has purchased 120,000 tons of crushed stone ballast, also 3,000 tons of 130-lb. rail and 1,500 tons of track fittings to be supplied by the Buffalo plant of the Bethlehem Steel Company.

Are Defective Rails Safe?*

Some types of potential failures require immediate removal from main tracks, while others can be allowed to develop for some time before this becomes necessary

By C. W. BALDRIDGE
Assistant Engineer, Atchison, Topeka & Santa Fe, Chicago

ONE of the most important duties of the trackman is to familiarize himself with the types of defects that exist in rails and to know which of them require immediate or eventual removal of the rail from service. As with most of the materials in common use, rails may have a wide range of defects, some of which are of vital importance while others are minor in character, so far as the life and service of the rail are concerned. These defects fall into two classes—those which are inherent in the material and those which result from external damage subsequent to manufacture. Only those types which may result in failure will be discussed.

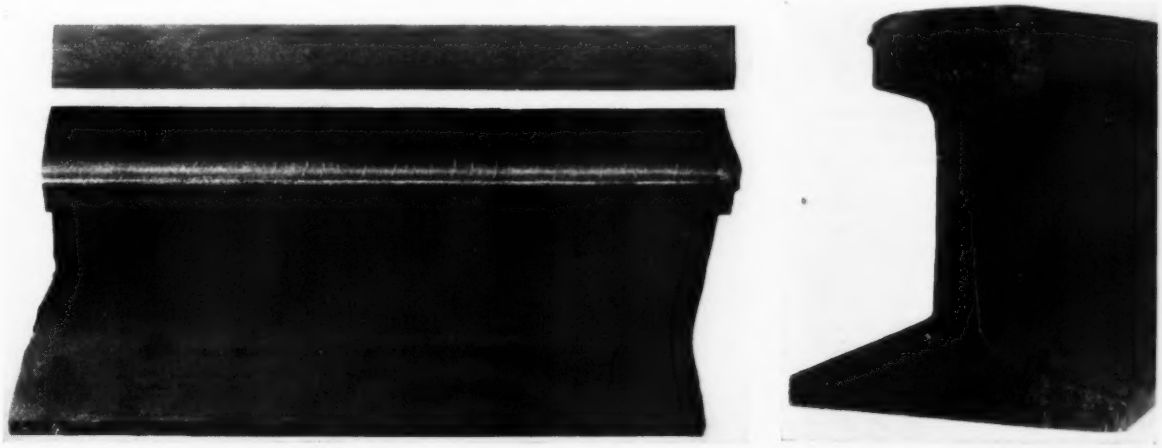
Most, but not all, defects do not require the immediate removal of the rail from the track, even though they will eventually result in a failure. For this reason, any discussion of the defects which require the removal of the rail should include a study of the extent of the development which is permissible before it must be removed from main-track service. To make such a study it is best to start with the most dangerous type and follow with those of decreasing importance.

Most Dangerous Type of Defect

The most dangerous defect in rails is generally conceded to be the transverse fissure. Whatever causes the rough-spot nucleus from which these fissures have their beginning, is the basic cause of the failure of the rail, and the fissure is the most dangerous of all defects because it gives less advance warning of its existence than any other type. Rails which fail from transverse fissures usually fail suddenly and the first knowledge that they are afflicted with this defect may come as a result of the failure. If it is known, however, that any rail has a transverse fissure or a rough-spot nucleus in it, it should be removed from main track at once. By means of the detector car this information can now be obtained in advance of the failure, provided the transverse fissure has started to form.

Head Check Is Second Dangerous

Without doubt the second most dangerous type of defect is the head check or detailed fracture, the two terms apparently being synonymous. This type of failure consists in the development of transverse cracks along the gage edge of the head of the rail, which gradually deepen, leaving a defect in the rail that appears to be one-fourth of a transverse fissure, with its initial point, or nucleus, at the surface of the rail head on the gage edge of the face.



These Views Illustrate a Head Check or Detailed Fracture. That at the Left Shows Transverse Cracks Along the Gage Edge of the Head of the Rail, Which Gradually Deepen Leaving What Appears to be One-fourth of a Transverse Fissure as Shown in the Section at the Right

These fractures apparently develop as a result of the distortion of the metal under the tractive pull of the driving wheels of locomotives when working to their limit, and are found most generally on the low rail on curves which are located on heavy grades. The head check can be prevented by changing the chemistry of the rail steel, to produce a harder and tougher rail. Rails with head checks always show the surface cracks for some time before complete failure results, and if the track men are watching for them, such rails can be re-

*This was submitted for publication in the What's the Answer department, but because of its scope is presented here as an independent article. For further discussion see page 272.

moved before breakage occurs. They should be removed from the track before the cracks are visible for a space of one-half inch on the surface.

Perhaps the next most frequent cause of rail breaks is the horizontal split head. This defect usually is indicated first by the development of a dark (wear) spot along the edge of the running surface of the rail, most frequently on the gage side. If the rail is allowed to remain in the track, the spot will continue to flatten or depress and in most cases a crack will make its appearance along the side of the head. This defect, if allowed to grow, usually results in a compound fracture of the rail. All rails showing spots of this character must be watched carefully and when the cracks along the side of the rail head are noticeable or the flattening on the top of the head becomes readily visible, the rails should be removed from track. Roadmasters and foremen should confer regarding the condition of such rails, for the question of their removal must be governed largely by experience and judgment.

Vertical Split Head Gives Warning

The next type in order of importance probably is the vertical split-head rail. In practically all cases, this defect gives ample warning of impending failure by the vertical splitting at the end, if the defect happens to be at the end of the rail, or by a mashing down and widening of the rail head if away from the end. They can nearly always be detected before the fracture works to the surface, by the typical dark streak on the running surface of the rail which results from the widening of the head as the fracture makes progress in the interior of the metal.

If allowed to remain in track, the vertical split will eventually produce a crack in the upper part of the fillet between the head of the rail and the web, since this type, while forming close to the running surface of the rail, invariably develops downward. These rails should be removed from track as soon as the splitting or mashing down becomes visible. They should never be left until the crack appears on the surface in either the face of the rail or in the upper part of the web.

Next on the list should be mentioned the fillet-crack failure. This type consists of a horizontal crack which develops in the web of the rail at the bottom of the fillet which connects the head and the web. Most of these failures occur in the low rail on curves or in rails in crossings and platforms, where they are more or less buried. This type develops slowly and usually the rail need not be removed from track until the crack has become slightly visible on the side opposite where it started. It can best be detected by the use of a small mirror which enables the inspector to see the underside of the head and top of the web of the rail.

Split Web Failure

Another occasional defect, which invariably results in failure of the rail, is the split web. When a split or crack is discovered in the web of a rail, it is usually found that the rail has been struck on the web by a spike maul or some other tool. Once in a while, however, a cracked web results from faulty manufacture or other conditions which do not result from external damage. Every rail found with a crack in the web, other than a fillet crack, should be removed at once, since such cracks are quite sure to continue their development, sometimes rapidly, until a broken rail results.

Another type of failure that is also found occasionally is the half-moon break in the base of the rail. Except when caused by derailment, this failure is almost always the result of two factors which occur together, the first being a lap seam in the base of the rail and the other an uneven bearing on the tie or tie plate. Derailed wheels, however, are relatively frequent causes of similar breaks in the base. The half-moon break in the base rarely causes immediate failure of the rail and it is reasonably safe to drill rails having this damage and apply joint bars, particularly if long joint bars are available, and leave the rail in service. If this is not done, the rail should be removed from the main track.

The Bolt Hole Break

A form of failure that is relatively frequent is the bolt-hole break. This failure occurs as a splitting of the web of the rail from the bed, through one or more bolt holes. Most frequently it eventually breaks out to and through the top of the rail, but sometimes it breaks through to the bottom of the rail, and occasionally to both top and bottom. When this type of failure occurs, the rail must be removed at once, even though the failure is still in its incipient stage.

The last and least dangerous type of defect is the scrappy-head rail. In this defect, chips or flakes of metal come loose from the head, or other rough spots develop in the metal of the rail as a result of some condition in the rolling, but not caused by a faulty condition of the metal itself. Where a scrappy head causes rough riding track, or where it appears to have weakened the rail to a considerable extent, the rail should be removed from track.

In addition to the inherent defects which require the removal of rails, there are a few which result from external damage which should be mentioned. A rail nicked by a broken wheel should be removed from track promptly if the nick is in the base of the rail. If the nick is in the head of the rail, however, it must be very deep to cause much risk of failure. A nick in the head will more often cause rough riding conditions, which necessitate its removal, than danger of breaking of the rail.

Driver Burns May Be Serious

Another type of damaged rail which sometimes makes the removal of a rail necessary is the driver burn. In this case the damage is done by the spinning of the driving wheels of a locomotive while the train is stalled. If driver burns are made when the engine is stalled in a snowdrift, the rail will be quite likely to break, particularly if it takes place in cold weather, if the burns are at all deep.

Burns which occur in cold weather but not in snow are also sometimes dangerous, but those that are made in warm or even mild weather will be more likely to develop into flat spots, with a spreading of the rail head, before final failure takes place. Kinks and bends in rails sometimes make their removal from track necessary because of rough riding conditions, but are rarely the cause of broken rails.

In the matter of reusing failed rails in sidings: Very few rails that have not failed through defects ever remain in main-line tracks until they are wholly unfit for use in side tracks. On the other hand very few rails which are removed from main track because they are defective or damaged, are suitable for reuse in passing tracks, important switching leads or other frequently-used sidings. The reuse of failed rails should, therefore, be confined to the less important side tracks and parts of sidings where engine movements are infrequent. If used in such locations, considerable salvage value can be recovered from rails which are no longer fit for use in main tracks or important sidings.

Inside and Outside Guard Rails on a Short Through Girder Span

Why Use Guard Rails on Bridges?*

A report on the functions of inside metal guards and of outside fender timbers and a review of practices regarding their installation and use

THE details of decks on open-floor bridges have received critical study during the past few years. Timber decks on steel spans have been changed radically to accommodate increased engine and car loadings and to reduce maintenance costs. This has resulted in the use of a higher grade of material and the employment of means to get longer service from it. There is evidence, also, of a trend towards the use of ties having larger sectional area but shorter lengths and toward the elimination of timber guard rails entirely or the use of smaller timbers for this purpose. Consideration of the merits of inside metal guard rails and outside timber guard rails is so closely related to a consideration of bridge decks as a whole that the committee determined upon the use of a questionnaire as a means of developing the trend of current practice and opinion, and much of the report is based on the information obtained from the replies received to this questionnaire.

What They Are For

In the opinion of the committee, inside and outside guard rails perform separate and distinct functions. The function of the inside guard rail is to keep the lateral displacement of derailed equipment within limits that will minimize the opportunity for serious damage to the track or the structure. The function of the outside guard rail is to insure the normal spacing of the ties, and prevent buckling of the ties in the event of a derailment. This view was clearly set forth in an editorial in the Railway Review of October 23, 1915.

Guard timbers cannot well answer the purpose of guard rails, for two reasons: In the first place, a timber guard presents an obstruction of yielding material into which a bouncing wheel will bite and climb over. This well-known fact led to the old practice of facing the upper corners of timber guards on the track side with an angle iron to prevent derailed wheels from getting a hold in the timber. While the metal facing did accomplish that purpose, there was still the objection that any guard outside the track was in the wrong place to guide derailed wheels properly and prevent increased slewing of the truck. When a truck is derailed, the wheels which drop inside the rails are the ones in advance in case the truck becomes slewed, as it usually does, and each wheel which falls outside the track swings somewhat to the rear of its mate on the same axle. Any obstruction or retardation of these outside wheels will therefore operate to slew the truck further, whereas a guard rail placed to retard the leading wheels is just what is desired to act in a manner to straighten the truck in the track. The inside rail is, therefore, the logical arrangement.

The following conclusions with respect to the use of guard rails for wooden bridges and trestles are quoted from the Manual of the American Railway Engineering Association for 1929:

1. "It is recommended as good practice to use guard timbers on all open-floor bridges, and the same should be so constructed as properly to space the ties and hold them securely in their places.

2. "It is recommended that the guard timber and the inner guard rail, when used, shall be so spaced in reference to the track rail that a derailed truck will strike the inner guard rail without striking the guard timber. The inner guard rail should not be higher or more than one inch lower than the running rail.

3. "It is recommended as good practice in the installation of inner guard rails to extend them beyond the ends of the bridges for such distances as is required by local conditions, but that this distance, in any case, be not less than 50 ft.; but that the inner guard rails be fully spiked to every tie, and spliced at every joint; that the inner guard rails be some form of metal

* This comprises an advance printing in abstract of a report prepared by a committee of the American Railway Bridge and Building Association for presentation at the convention which was to have been held in October, 1931. Because this convention was postponed until October, 1932, the association has authorized the publication of this report in *Railway Engineering and Maintenance*.

The personnel of the committee is: C. A. J. Richards, chairman (P. R. R.); E. E. R. Tratman (Engineering News-Record); A. E. Bechtelheimer (C. & N. W.); Thomas E. O'Brien (D. & H.); J. S. Huntoon (M. C.); B. R. Meyers (C. & N. W.); A. B. Scowden; (B. & O.); H. C. Swartz (C. N. R.); and R. C. Young (L. S. & I.).

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section; and that the ends be beveled, bent down, or otherwise protected against direct impact with moving parts of equipment.

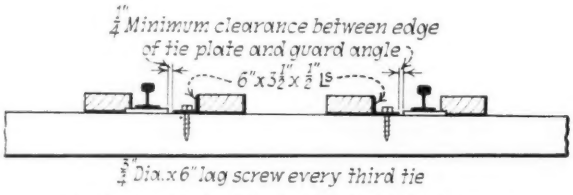
4. "It is recommended as good practice to use inner guard rails on all open-floor and on the outside tracks of all solid-floor bridges and similar structures longer than 20 ft. in main-line tracks, and on similar bridges and structures in branch-line tracks on which the speed of trains is 20 miles per hour or more."

Inside Guard Rails

Open-Floor Bridges—Practically all of the railroads canvassed use *T*-rail guard rails between the running rails. Generally these T-rails are the next size smaller than the running rails, although the sections used vary from 50 to 100 lb. per yard. They are placed from 8 in. to 10 in. from the gage of the running rails. In some cases important bridges are equipped with structural shapes backed by timbers. Some of these special features are described later in this report.

It is general practice to extend the inside guard rails far enough beyond the bridge ends to straighten out derailed trucks before they reach the bridge, but there are differences of opinion as to the lengths required to do this, even where not affected by alinement or other local conditions. The majority of railroads use a minimum of 50 ft. for single-track bridges and for the approaching ends of multiple-track bridges. On other roads the distance varies from 30 to 100 ft. The lengths provided on the leaving ends of multiple-track bridges vary from 8 to 100 ft. There is no agreement as to the necessity for inside guard rails on multiple-track bridges. Many roads provide them on each track, others on outside tracks only, and some provide only one guard rail on each outside track and this is placed adjacent to the inside running rail.

Most roads bring the ends of the inside rails together and fasten them to a frog that has its point bent down or beveled to an elevation considerably below the top of the running rail. In some cases specially designed castings are used instead of frogs. One road places the inside



Inside Guard Rails of Timber Faced with Angle Irons

guard rails parallel with the running rails throughout, and bends the extreme ends of the rails down to the level of the base of the running rails. Another paragraph of the editorial in the Railway Review of October 23, 1915, states:

"The best arrangement for the ends of inside guard rails has long been a debatable question. The plan in most common use is to run the two guard rails to a point in the middle of the track on the grade some distance from the ends of the bridge. The objectionable feature of this arrangement is that in the somewhat rare case of wheels derailed a lateral distance exceeding half the track gage, such wheels will take the wrong side of the point and will be thrown still further out of line, thereby breaking the train and piling up the cars or throwing them into the truss, in the case of a through truss bridge. Careful students of the question therefore saw the desirability of such a guard rail arrangement that derailed wheels would in no case be thrown into a worse position than that in which they were running when coming upon the bridge. Reference is made to the use of three straight guard rails, the ends of which are turned down into the ballast beyond the bridge instead of being brought to a connection above the ties. Two of the guard rails are at the usual distance of eight or ten inches inside the running rails and the third is in the middle of the track. By this arrangement derailed wheels, whatever their position, are prevented from becoming further slewed, but the guard rails offer no obstruction that is intended to straighten up a slewed truck on the bridge.

Ballasted Decks—It is the usual practice to have the same requirements for inside guard rails on ballasted decks as on open decks, although some roads use them on curves only, or where they are required by some local condition.

Trough-Floor Bridges—In this type of bridge the sections of the troughs which extend above the floor take the place of the inside guard rails.

Timber Bridges—On many roads pile and frame bridges are not equipped with inside guard rails unless

In this Case the Angle Iron Is Placed Over the Timber Inside Guard Rail

they are on sharp curves or serve as approaches to steel spans. Where they are used, the construction is generally the same as on open-floor bridges.

Special Types—A few roads use structural steel angles backed by timbers, instead of T-rails, for inside guard rails. This construction is used mainly on large and important structures. One type calls for two lines of angles 6 in. by 3½ in. by ½ in. laid inside the running rails. Each angle is laid with the 6-in. leg on the ties, and with the inside face of the vertical leg spaced 10 in. from the gage of the running rails. They are held in place by lag screws through the horizontal legs and into the ties. They are backed by 4-in. by 8-in. timbers laid flatwise and against the outside vertical faces of the angles. A line of 4-in. by 8-in. timbers is placed outside of each running rail. This construction protects the ties from being cut by wheel flanges in case of derailment.

Another type used in special cases consists of two angles, 6 in. by 4 in. by ½ in., in combination with two 8 in. by 6-in. timbers. The timbers are bolted through every second tie. The angles are placed so as to protect the timbers, with the 6-in. legs on top and the 4-in. legs extending downward adjacent to the running rails. These timbers are placed 10 in. from the gage of the running rails. The angles are held in place by lag screws extending through the horizontal legs of the angles and into the timbers. Lag screws are placed 2 ft. apart.

Outside Guard Rails

Nearly all of the roads canvassed use outside timber guard rails on open-deck bridges one road uses outside metal guard rails, and another road does not use outside guard rails at all. There is considerable variation in the distance that they are placed from the running rails, the minimum spacing being 10¾ in. and the maximum 36¾ in. from the gage of the running rail to the near edge of the guard rail. It is agreed, however, that they should be placed beyond the reach of derailed trucks that

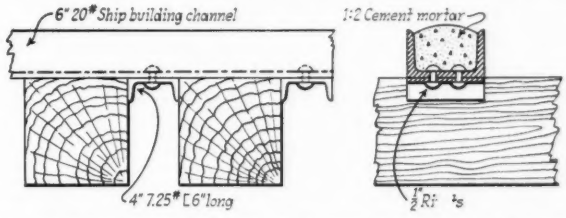
are held in line by the inside guard rails, as otherwise their function of keeping the ties from bunching would be destroyed. There is another point in favor of keeping the outside guard rails relatively distant from the running rails. In case the derailed trucks jump the inside guard rail the outside guard rail, if too close, will serve to retard the outside wheels of the trucks, cause further slewing and result in serious damage to the structure.

The outside timber guard rails now in use vary from 7 to 9 in. in width and from 4 to 7 in. in thickness. Some are dapped over the ties from ½ in. to 1 in. and others are not dapped at all. While the railways are about equally divided with respect to the practice of dapping, there seems to be a trend away from this practice. The increasing use of treated timber has influenced this tendency because field framing is objectionable and preframing is not possible unless all ties are of uniform width.

There is considerable variation in the methods of anchoring guard rails to the ties, although much the same methods are applied to both dapped and undapped timbers. The use of a lag screw in every tie is favored by about as many as prefer the use of a bolt in every third tie. A few roads use bolts in every tie, or bolts and boat spikes, or bolts and lag screws, or boat spikes.

Special Types—One road makes use of a metal outside guard rail. It consists of a 6-in. channel, laid with the flanges up, and bolted to every fourth tie. In the space between the ties, 6-in. lengths of 4-in. channels are placed transversely with the flanges down. The 4-in. channels are riveted to the 6-in. channels, thus forming a very effective outside guard rail and tie spacer. After these guard rails are in place, the 6-in. channel is filled with 1:2 cement mortar or mastic.

Tie Spacers—A number of railroads report the use of special appliances for spacing the ties, in conjunction with the outside guard rails. Various kinds of metal tie spacers are in use. A device used on one road consists of a piece of heavy-gage sheet metal that has been punched in such



Special Outside Guard Rail, with Tie Spacers, Constructed of Channels

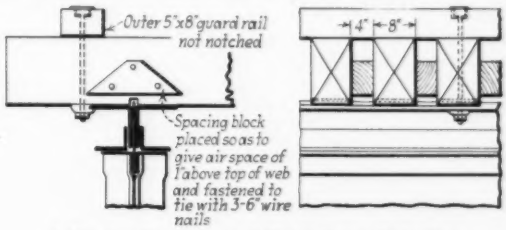
a fashion that triangular shaped teeth project from both faces. When these plates are placed between the guard rail and the ties, and the guard rail is drawn down into place, the teeth are forced into the wood and hold the two timbers rigidly in place.

Outside Guards Foul Snow Flangers

A northern road discontinued the use of outside guard timbers because they fouled snow flangers. This road now uses one line of T-rails placed 12 in. outside of each running rail, and 4-in. malleable iron tie spacers between the ties. The tie spacers are placed 6 in. from the ends of the ties and are fastened with 10-d nails driven into the tops of the ties. The T-rails are the same section as the running rails. This construction has been in use for 20 years on this road.

One type, known as flange guards, consists of blocks two feet long beveled lengthwise so that the top surface slopes from the top of the ties under the running rail to the bottom of the ties beyond the outside edge of the girder or stringer flange on which the ties rest. These are held in place by spikes in the sides of the ties and are covered with a heavy coat of paint or other protective material. Incidentally these blocks protect the steel from the brine drip from refrigerator cars. A variation of this plan is a spacing block that is beveled both ways from the middle at the top. These blocks are cut from 6-in. timbers and are attached to the ties by 6-in. wire nails so that they will clear the steel about 1½ in.

Another type, consisting of three lines of wooden spacer blocks which are placed between the ties at the ends and at the center, is used with three lines of T-rails


Outer 5"x8" guard rail not notched
4"
8"
Spacing block placed so as to give air space of 1" above top of web and fastened to tie with 3-6" wire nails

A Wooden Tie Spacer and Girder Flange Protection

between the running rails, the outside guard rails being dispensed with. One northern road commenced using 4-in. by 4-in. spacing blocks more than 50 years ago. These were provided in addition to dapped guard timbers.

Summary

It is apparent from the information furnished that: (1) Both inside guard rails and outside guard rails are in general use; and (2) T-rails for inside guard rails and timbers with or without daps for outside guard rails are generally preferred.

The committee considers it advisable to use T-rails of the same or slightly less height than the running rails, spaced about 9 in. from the running rails with or without rail braces and brought together at a point beyond the ends of the bridge. The outside guard rails should be spaced 18 in. from the gage side of the running rails, unless the detail of deck anchorage to the superstructure makes this impracticable. If not dapped, the timbers may be 4 in. by 8 in. or 5 in. by 8 in. in section, laid flatwise, and fastened to each tie with lag screws. Where some form of tie spacer is used between the ties, the lag screws may be more widely spaced. If dapped, the timbers may be 6 in. by 8 in. laid flatwise, with daps 1 in. to 2 in. deep, and fastened to each tie with bolts or lag screws. Since the outside guard rails may prevent serious damage in case of derailment, it does not seem desirable to eliminate them. Rather, it appears desirable to increase their effectiveness by reinforcing them with tie spacers.

Skeletonizing Track on the Chicago, Milwaukee, St. Paul & Pacific

Interesting Drawing Is Big Safety Help

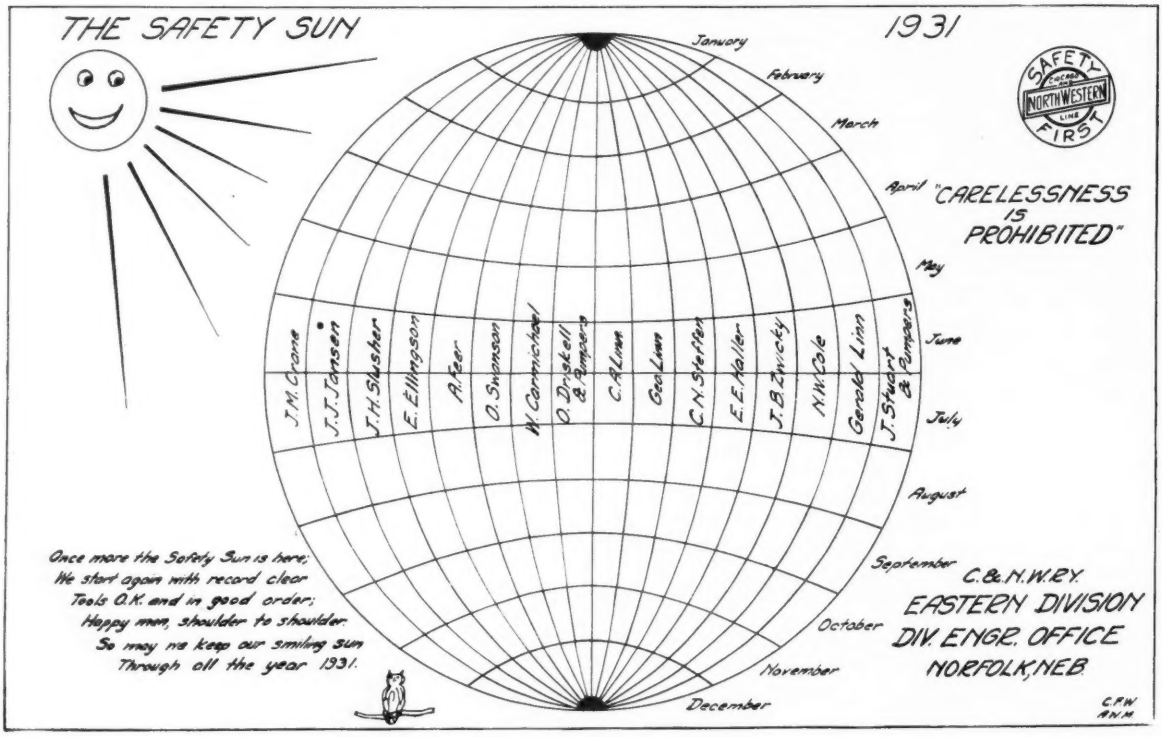
BRIDGE and building foremen on the Eastern division of the Chicago & North Western are informed monthly of their respective safety records by means of a "Safety Sun," on which the safety standing of each foreman on the division for that particular month and for each preceding month in the year is clearly depicted.

The Safety Sun is issued in the form of a blue print. The original drawing is 8½ in. by 14 in. and contains a centrally-placed circle, 8 in. in diameter, which is divided into sections by lines corresponding to the lines of longitude and latitude of the earth. The lines of longitude or vertical lines divide the globe into a number of vertical sections corresponding to the number of bridge and building foremen on the division. The name of a foreman is lettered in each one of these vertical sections.

The lines of latitude divide the globe into 12 horizontal sections, each of which represents a month. The space for January is at the top of the globe, which corresponds to the north pole, and the December section is at the bottom, which corresponds to the south pole. The names of the months are lettered at the right of the globe opposite the respective sections. In the upper left corner of the drawing is depicted the Safety Sun, the features of which are a reflection of the safety performance of the division as a whole.

Reportable injuries are indicated on the drawing by shading. Thus, when a reportable injury occurs in any foreman's gang, the section of that foreman for the month in which the injury occurs is shaded, and if more than one injury takes place in that gang in the same month, the number of injuries is indicated in the same space. In this manner a progressive record is kept of the safety performance of the bridge and building foreman and, since the Safety Sun is issued once a month to all the foremen on the division, each individual foreman is naturally anxious to keep his record clear.

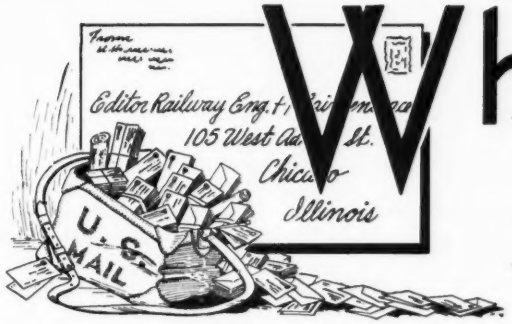
A further spirit of rivalry is introduced into this scheme by the fact that on this division there are two supervisors of bridges and buildings, each of whom has eight foremen under his jurisdiction. The foremen are placed on opposing sides of the center vertical line of the globe, those on the left being under one supervisor and those on the right of this line being under the jurisdiction of the other.



A Reproduction of the Safety Sun for 1931

The Safety Sun was originated on this division several years ago and has proved a success in stimulating interest in safety work. We are indebted for the above information to C. F. Womeldorf, division engineer of the Eastern division of the North Western, at Norfolk, Neb.

Along the Main Line of the B. & O. Near Cumberland, Md.



What's the Answer?

Have you a question you would like to have someone answer?

Can you answer any of the questions listed in the box?

To Be Answered in June

1. How many man-hours are required for the renewal of a main-line turnout? For one in a yard or siding? What effect, if any, does the weight of the rail, the number of the turnout or the character of the ballast have?

2. What is the best method of removing dirt and scale from steel bridges that are to be painted?

3. How should burrs be removed from the heads of track chisels? By whom should this be done? What precautions should be observed?

4. To what extent is it practicable to insulate the roofs of railway buildings? How can this be done to best advantage?

5. When adzing ties by hand for new rail, should the cutting be done with or across the grain? Why?

6. What is water hammer? How is it caused and what are its effects? What means can be employed to eliminate or minimize these effects?

7. If sufficient tie plates are available for only one rail on a curve, should they be placed under the high or the low rail? Why?

8. Where bridge shoes are cutting into concrete or old stone bridge seats or other forms of failure occur in bridge seats on piers and abutments that are otherwise sound, what methods should be employed to overcome the trouble? How should the work be done?

When to Do Gaging

At what season, or in connection with what other work, can gaging be done to best advantage? Should it be done out of face? Why ?

Best Time Is During Tie Renewals

By J. R. WATT

Engineer Maintenance of Way, Louisville & Nashville, Louisville, Ky.

Gaging should always be done in connection with tie renewals, and also when the track is being given a general surface. If new ties are gaged as they are inserted, and the gage is adjusted elsewhere as necessary, much spiking and respiking will be avoided and the life of the ties conserved. It will be necessary to do the gaging out of face in order to insure a proper line for the track.

There Is no Closed Season on Gaging

By C. R. SCHOENFIELD

Roadmaster, Chicago, Burlington & Quincy, Aurora, Ill.

There is no closed season for gaging, this being one of the most important features of track work. Foremen should be educated to the fact that the gage is as necessary as the levelboard when smoothing track.

The proper time to do general gaging is during tie renewals and when the track is being surfaced, and the gage should afterwards be maintained along with other work, since it is too important to neglect at any time or under any circumstances.

Gaging Less Arduous than Formerly

By A. H. REETZ

Supervisor of Track, Minneapolis & St. Louis, Hampton, Iowa

Before the days of heavy rail and large tie plates, seasonal gaging was a matter of large importance and was generally done during the winter to avoid interference with the summer program. Where tie renewals were heavy this work might be done in connection with the renewal program, however. At present, gage does not give the trouble that it did formerly, particularly on lines where the standard of maintenance is high, except, perhaps, on curves.

Wide gage on curves is due, in part at least, to curve wear of the rail. Here, gaging can be done to good advantage in the winter, since it must be done out of face. If done at this season it is out of the way of the summer program, while tight rail is not likely to add any complications. On tangents it is preferable to do such gaging as is necessary in connection with tie renewals.

Can Be Done at Any Season

By M. H. MOSES

Section Foreman, Seaboard Air Line, Ragland, Ala.

There is no reason why gaging cannot be done at any season. It can be done to best advantage, however, during tie renewals, since the new ties can be spiked to correct gage and will not need respiking for a long period. The intermediate ties should then be gaged at once, otherwise line cannot be maintained and a heavy strain is placed on the spikes of the properly-gaged new ties.

It is also of considerable advantage to gage out of face immediately in advance of general surfacing. If the gaging is done after the track is raised, more smoothing is necessary, since the slight change in the position of the tie plates, although the shift may be very small, will

nearly always be followed by settlement, and thus affect the surface. Furthermore, if the ballast is fine, some of it may run under the ties while they are being nipped for the spikes, thus affecting the surface still further.

[Owing to the large number of answers submitted to this question, 15 answers having been received, space will not permit all of them to be published. For this reason, four were selected for publication, which were considered to be most representative. It is of interest, however, that most of the discussions indicated a belief that gaging out of face is required and the best time to do this is in connection with tie renewals or a general surfacing operation. Among those who expressed this opinion were W. Rambo, roadmaster, Missouri Pacific; W. H. Sparks, general inspector of track, Chesapeake & Ohio; L. G. Byrd, bridge and building supervisor, Missouri Pacific; John Bednarz, section foreman, Great Northern; W. R. Garrett, yard foreman, Chicago, Burlington & Quincy; Burt Hurst, section foreman, Missouri Pacific; and J. J. Hess, general roadmaster, Great Northern. The latter believes, however, that regaging out of face is unnecessary unless the gage is ½ in. wide.

L. J. Drumeller, division engineer, Chesapeake & Ohio, said that gaging out of face should be done in connection with new rail shortly after it is laid, and that trackwalkers can do considerable gaging in connection with their other duties. H. Becker, section foreman, St. Louis-San Francisco, favors the practice of gaging out of face during the winter, although he said that the gage should also be corrected in connection with tie renewals. E. E. Valentine, section foreman, New York, Chicago & St. Louis, expressed the same opinion, but called attention to the fact that new rail should always be gaged out of face when it is surfaced, and that further gaging may be necessary some months later. G. W. Evans, section foreman, Missouri-Kansas-Texas, is of the opinion that if the track is maintained to the proper standard, gaging out of face is seldom necessary, except on curves. —Editor.]

Defective Rails

What defects require the removal of rail from main tracks? What defects, if any, are permissible in rail that is laid in sidings ?

The List of Defects and Damage Is Long

By W. H. CLEVELAND

General Track Inspector, Atchison, Topeka & Santa Fe, Wellington, Kan.

Every defect, whether inherent in the rail or the result of damage, which renders a rail unsafe, requires its removal from the track. Specifically the more important defects include transverse fissures, compound fissures and all rails from heats which have had failures of these types; advanced or progressive split heads; crushed heads; longitudinal fissures, or pipes; flat spots in the ball, which are indications of lateral fissures or head checks; cracks in the fillet or web; and wheel burns, particularly those having large, deep, crystallized spots, especially rails burned during cold weather or when encased in snow, so that they chill almost instantly.

A frequent form of damage occurs from broken wheels, which sometimes travel for some distance, nicking the rails on the head or base. Experience and good judgment are required to select such rails for removal. Base breaks from this cause should be removed at once or protected with angle bars until removal. Considerable damage can occur to the head, however, before it becomes unsafe. If the blow has been of sufficient magnitude to produce a chisel-like depression or if the metal is distorted enough to show a visible kink in the ball and a skin disturbance as far as the fillet or web, the rail contains deep fractures and is unsafe, since it is almost certain to fail under reflex movement between the wheels.

There is no well-defined limit to the use of defective rails in sidings, providing both the rails and the sidings are properly classified, although considerable judgment must be exercised in culling out the rails which should be relegated to the scrap pile.

All Defective Rails Should Be Removed

By C. B. BRONSON

Assistant Inspecting Engineer, New York Central, New York

From the standpoints of safety and protection it is a matter of the utmost importance that all defective or fractured rails be removed immediately from main line tracks. Rails which have broken, disclosing fissures of either the transverse or compound type, or which show surface evidence of their existence, rank first in importance and should be removed immediately, regardless of the time of day or night when they are discovered. Straight or angular breaks fall in the same category, although our experience indicates that this type of failure has its origin in a base seam or moon-shaped base fracture which progresses upward through the section. At present such failures are far less than fissures in either number or percentage. The bolt-hole break, in which a piece of the head is detached, is another type of rail failure requiring immediate replacement, even though protected to some extent by the splice bars.

Split heads, while generally of slow and progressive growth, must likewise be removed, as soon as the surface indications of their presence become apparent. This applies to both the vertical and horizontal types of these defects. Crushed heads are of less importance than the defects which have been mentioned, yet they should be removed as soon as their existence is known. Rails containing moon-shaped base breaks are of similar importance.

Several other classes of defective rails are replaced from time to time, which do not necessarily represent defective metal. This includes badly mashed or flowed-head rails on the low side of curves, stock rails, etc. Occasional badly mashed or chipped ends also require removal of the rail.

In addition, rails damaged in service, such as those nicked on the head or elsewhere by broken wheel threads, by derailments or from other causes, and rails that are surface bent to a considerable extent, all require removal. We conduct a yearly campaign to remove all rails that have been burned by wheel slippage, where field examination indicates that such action is desirable. Considerable judgment is required to determine what rails of this character should be removed.

Rails in sidings present a different problem, the importance of which depends on the use to which the siding is put, since a storage siding calls for different treatment from a passing siding. In general, fissured rails of any type split-head rails should not be used. Bolt-hole failures make the rails unusable unless they are sawed and redrilled. Crushed-head or moon-break rails can be used on storage tracks but not on passing or other busy sidings. Burned or bent rails are satisfactory only on storage sidings.

While these statements cover the general policy that should be followed in determining minor uses for defective or damaged rails, judgment on the part of the

supervising staff plays an important part in making the individual determinations.

[Eight answers were received to this question, of which the two published are typical. All of those who contributed to this discussion agreed that certain defects make the removal of rails imperative, but that considerable judgment is required with respect to others. I. C. Ellison, roadmaster, Missouri Pacific, believes that foremen must maintain a constant lookout for defective rails, but that the detector car is of much aid in finding hidden defects, and recommends its use over primary lines once every two months and at three-month intervals on secondary lines. Robert White, section foreman, Grand Trunk Western, made special mention of head-checked rails and their indications, and mentioned the value of the detector car. Similar discussions were received from Henry Becker, section foreman, St. Louis-San Francisco; W. R. Garrett, yard foreman, Chicago, Burlington & Quincy; and Burt Hurst, section foreman, Missouri Pacific. A longer discussion of this subject by C. W. Baldridge, assistant engineer, Atchison, Topeka & Santa Fe, appears elsewhere in this issue.]

Assigning Pile Drivers

Should each division of a railway be given a permanent assignment of pile-driver equipment? If not, how should the assignment be made, and how can the routine work of driving piles be handled ?

Supplementary Equipment Is Available

By A. B. SCOWDEN
General Inspector of Bridges, Baltimore & Ohio, Cincinnati, Ohio

A division requiring the exclusive use of a pile driver is an exception, particularly one consisting largely of primary main line. Divisions made up largely of branch lines will require a larger use of this equipment and the assignment should be made on this basis. For each machine a "home" division should be selected which carries the crew, consisting of an engineer and fireman, on its rolls. The driver should also be assigned to work on one or more adjoining divisions as needed, the transfer of the machine being subject to instructions of the chief maintenance officer for the territory, who should prepare and follow a regular working schedule for the driver. When away from the home division the regular crew should accompany the machine, but the supplementary crew for manning the leads and turning mechanism should be provided by the division on which it is working. During idle periods, the driver should be held on the home division, which should be responsible for both running repairs and heavy maintenance.

While pile drivers designed specifically for this class of work are used extensively, other equipment having less limitations of service has been encroaching on its once exclusive field in recent years. Locomotive cranes with swinging or braced leads, equipped with steam hammers, can often be used to advantage when working from the track, particularly where there is no train interference or where the machine can clear trains quickly. Where tracks are inaccessible or it is desired to be independent of work-train service, crawler-mounted cranes, convertible shovels and tractors with pile-driving attachments have been used successfully. Locomotive cranes can be used to drive concrete piles, which an ordinary driver is unable to handle because of their weight.

While locomotive cranes are ordinarily considered to be division equipment, the varied duties which they are required to perform leaves little time for pile driving, so that few of them are equipped with pile-driving attachments. The machines which are so equipped are often considered as system equipment and are handled in the same manner as the regular pile drivers. Assigned in this manner they provide additional facilities for driving piles when the demands are beyond the capacity of the regular pile drivers, and at other times they are available for other classes of work.

Permanent Structures Reduce Pile Driving

By F. E. BATES
Bridge Engineer, Missouri Pacific, St. Louis, Mo.

As the replacement of pile trestles with permanent structures progresses and the use of creosoted timber increases, the mileage of untreated trestles is being greatly reduced, so that the amount of pile driving that must be done is constantly growing less. As a result, the annual pile-driving program on a division can be completed in a relatively short time. Pile-driver equipment assigned permanently to a division will, therefore, lie idle a large part of the time, unless it can be put to other uses. The standard type of pile driver, being designed for a specific purpose, is not suited for other classes of work and little benefit can be gained from its use except for this one purpose.

Pile driving is a specialty and the best results can be obtained only from a gang organized and trained for this work. To obtain such results, it is believed that such a gang should consist of an assistant foreman, an engineer, a fireman and two pile-driver men. This gang can be shifted from one division to another, reporting to the proper division officer while under each assignment. It should be held responsible for the maintenance and operation of the machine, and should receive any necessary assistance from the local forces. This arrangement insures that the machine will be used to its maximum capacity and efficiency, while it avoids the duplication of responsibility which always occurs when such a machine is shifted without a crew.

Should Be Kept in Continuous Service

By L. G. BYRD
Bridge and Building Supervisor, Missouri Pacific, Wynne, Ark.

Since a pile driver of modern design represents a relatively large investment, two things should be kept constantly in mind by railway officers who are interested in this equipment. First, a machine which is designed for the specific purpose of driving piles is not suited for other classes of work, so that if there is not sufficient pile-driving work it must remain idle. Second, the number of such machines owned by a railway should be limited to the extent that all of them can be kept in service for the maximum practicable period every year.

Since few, if any, divisions have sufficient pile driving to keep such a machine in constant service, it follows that the system of divisional assignment is not suited to this class of equipment. If attempted, it is obvious that the railway will sustain a considerable loss that can otherwise be avoided.

In my opinion, pile driving work should be carefully scheduled, and a careful balance maintained to insure, on the one hand, that the machines will be kept in continuous service during the working season, and on the other that the work of no division will be delayed by its inability to secure the service of a machine when it is needed. In working out this schedule, the possibilities of delays as the result of cold weather, high water, rainy

seasons and other conditions not subject to control should be given serious consideration. It is the practice on our road to start the pile driving on certain divisions at times, and arrange the schedules on others in the manner, which experience has shown will avoid the probability of delays from the causes which have been enumerated.

Schedules for pile-driving and the assignment of the equipment in accordance with these schedules, should be prepared and followed by the engineer maintenance of way, who is thus able to co-ordinate the activities on all of the divisions. If this is done, delays to the equipment and idle time will be reduced to a minimum, while every division will be able to obtain the required service when it can be handled in the most economical manner from both the local and system standpoints.

Applying Waterproofing Primers

Should a primer be applied to a concrete surface before waterproofing materials are added? Why ?

Depends on the Bond Desired

By L. B. ALEXANDER
Consulting Engineer, Detroit, Mich.

If the overlying blanket of waterproofing is to be bonded to the surface, as is the common practice, a priming coat is desirable. Fine dust, not easily removable with a broom, will destroy, completely or in part, this bond unless a priming coat is used which will absorb it. The primer, which should be of a thinner consistency than the successive moppings, penetrates through any reasonable film of dust and is thus able to adhere to the concrete and form a bond for the first mopping. Most priming materials are water-repellent, so that they can be used on damp surfaces and thus provide the necessary bond quickly.

There Are Two Opposed Theories

By M. HIRSCHTHAL
Concrete Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

There are two diametrically opposite theories with respect to waterproofing, one of which insists that a built-up waterproofing of felt or cloth should adhere to the surface to which it is applied, otherwise the protection cannot be satisfactory, while the other holds that this form of waterproofing is merely a blanket or trough in which the water is held until it can drain away. Under the latter theory, if the water is kept from contact with the surface, it is not particularly important to obtain adhesion between this blanket and the concrete. In fact, if it remains independent, movements in the structure do not affect it.

Primers are used to insure adhesion of the waterproofing with the surface to be protected. Since standard waterproofing bitumens do not provide positively for such adherence, a primer becomes necessary under the first theory but is not required under the second. Regardless of the theory under which the work is specified, however, construction joints in the concrete deck require the special protection of a priming coat and also of an added ply of the reinforcing material. This is because they present the weakest points in the structure from the waterproofing viewpoint and should, therefore, receive the additional protection thus afforded.

In my opinion a priming coat is also essential for waterproofing (dampproofing) the backs of abutments and retaining walls and on culverts, all of which should be given a surface coating if they are not waterproofed by the cloth or felt method. Here the protection must not only be moisture-resistant, but it must also withstand the impact of the deposited fill as well as the frictional force exerted as settlement occurs, and, in addition, the vibrations due to live load during the early life of the fill. For these reasons, all of the adhesion that can be provided should be afforded to these surfaces, and this is best accomplished by means of a good priming coat.

A Matter of Long Discussion

By G. A. HAGGANDER
Bridge Engineer, Chicago, Burlington & Quincy, Chicago

This is a question which has been discussed for many years, yet remains unsettled. In my opinion, a primer should be applied wherever it is desired to have the waterproofing adhere to the structure. This is important in most cases in order that any leaks that occur will be localized. If the entire waterproofing blanket is loose, a puncture at one point will allow any water that may come through to spread over a large area. Where a structure is so designed that there is no chance for movement of the floor and consequent breaking of the reinforcing fabric, I believe a primer should be used to insure adhesion of the waterproofing blanket to the surface. Near joints, where some movement may always be expected, it is not good practice to fasten the built-up blanket to the surface, but to allow some space for it to stretch, if such movement does occur. For some distance on either side of the joint, therefore, the primer should be omitted and a sheet of building paper should be inserted between the waterproofing and the concrete surface to insure the elimination of the bond with the surface.

Horizontal or nearly horizontal surfaces generally have a film of dust. The mopping bitumen is so heavy that it does not penetrate this film and cannot, therefore, adhere to the concrete. The primer, on the other hand, is thin and will penetrate the film and absorb the dust particles or other foreign matter, so that it can adhere and thus form a bond for the heavier liquid.

Welded vs. Screwed Joints

What are the relative advantages of welded joints and joints made with screwed couplings or bolted flanges, for hot and cold-water lines, and low-pressure steam lines? Are welded joints suitable for high-pressure steam lines? What are the limitations, if any, of welded joints ?

Many Advantages in Welded Joints

By L. L. TALLYN
Division Engineer, Delaware, Lackawanna & Western, Scranton, Pa.

Welded joints demonstrate many advantages over threaded joints. I would liken the threaded joint to a weak link in a chain. Threads cut into a pipe remove about 50 per cent of the thickness of the pipe wall, thus reducing the pipe strength by this amount. A welded joint causes no loss in the thickness of the pipe, while the joint itself has about 85 per cent of the strength of the pipe itself. For these reasons the welded joint has a decided advantage for hot and cold-water lines, since the full thickness of the pipe is reserved to withstand

pitting and corrosion. I do not, however, advocate the welding of small lines connecting to fixtures.

The same observations apply to bolted-flange joints, since the flange is generally screwed to the pipe. Furthermore, welding avoids the probability of leaks which are common in both types of joint, while they eliminate the necessity of maintaining the gaskets. Welded joints are higher in first cost than screwed joints, but this difference is soon wiped out by the lower maintenance.

I see no advantage in welded joints for low-pressure heating lines, such as are used in small stations, in which the maximum pipe diameter does not exceed two inches. In low-pressure systems requiring pipes of large size, there is a decided advantage, however, in welding the joints in the mains and in welding the branch-line connections to the mains.

Welded joints are equally adapted for high-pressure steam lines, for the reasons already stated. I have used welded joints on high-pressure steam lines for many years and can state frankly that this practice has greatly reduced our maintenance costs.

Welded Joints Save Maintenance

By Assistant Engineer for Buildings

In recent years, it has become a widespread practice to apply welded joints to pipe lines. On our own road we started at the larger terminals, where the cost data could be obtained more readily, and then extended the practice to outlying divisions. The primary reason for using welded joints has been to reduce the cost of our pipe work, including both labor and the fittings.

Pipe-line work can proceed more rapidly with welded joints, primarily because of the absence of such fittings as elbows, tees, couplings, reducers, etc. It is not only the cost of the fittings that one must contend with, but the time it takes to get them on the job. The pipe must then be cut and threaded to get them in their proper location, and after this is done the pipe must be connected up. In a welded job the pipe can be assembled as fast as the welds can be made. This is then followed by burning the necessary holes for reducers and lateral connections and welding them on. Repair work can be accomplished and additional laterals applied with a welding outfit at any time without disturbing or breaking the line.

Welded joints are fully as suitable for high-pressure steam lines as for low-pressure lines. In fact, I think they are better adapted for this type of installation, since they give no trouble from leakage, while a properly made joint of this type is far stronger than joints which require the threading of the pipe.

I would limit the use of welded joints to pipes larger than 1½ in., since we do not find them to be economical for pipe of smaller diameter. As the size of the pipe increases, they demonstrate progressively greater economy. I do not consider it good practice, however, to provide welded connections for valves, expansion joints and other special fittings, since it may be necessary to remove them at any time.

Welded Joints Are Far Superior

By R. J. SOUTHCOTT

Water Service Foreman, Canadian National, Toronto, Ont.

I can see no comparison between welded and threaded joints. While it is impossible to make repairs or extensions to a welded line without the welding torch, we find it is much more simple to use the torch for these purposes, even on lines that are installed with screwed fittings, than it is to use the die stock. Repairs can be made in place with the torch, a faulty section can be cut out and replaced or a nipple for a branch connection can be welded in at any angle or in any location, without removing the line and in less time than is required to make the cut and thread the pipe for the branch line tee. Furthermore, this method eliminates the fittings, the threads in the pipe and such flanges as might otherwise be necessary.

In a new installation, the welded joint is far superior to the screwed coupling, provided the pipe is 2½ in. or larger. The pipe can be assembled with less labor; no "bull" work is required with chain tongs and bars, thus eliminating in large degree the risk of personal injury; while there are no leaks to consume the time of the maintenance forces on unproductive labor.

We are using welded lines for live steam up to 175 lb. pressure for both standard and extra heavy pipe up to the 12-in. size, and, except for an occasional faulty weld which was easily corrected, have had no trouble with leakage. We have also had good results from welded joints on hot and cold-water and low-pressure-steam lines. While we prefer die stock for small lines, the advantages of welding increase with the diameter of the pipe.

One of the advantages of welding is that cast-iron pipes can be brazed together, while good connections can also be made between cast iron and wrought iron or steel. There is a certain fire hazard where welding is done around frame structures, so that a pail of water and a squirt gun or a fire extinguisher should be part of the equipment of every welding outfit.

Removing Shims

Where the track has heaved, what precautions, if any, should be taken and what methods should be employed in the removal of shims while the frost is leaving the ground and the track is settling ?

Track Conditions May Be Very Bad

By District Engineer

It is often more difficult to handle heaved track when the frost is going out and the track is settling than to apply the shims while the track is heaving. Normally the frost enters the ground at a moderate rate, and the heaving can be cared for without undue effort. While track heaves out of level, it is seldom difficult to correct this condition when applying the shims, or to keep it level after the original application is made.

If winter ends suddenly, as it often does, with warm winds and bright sunshine, or when the frost is driven out by warm rains, the settlement in the track may be so rapid that the regular section forces must be increased temporarily in order to keep up with the settlement and insure that the track will be maintained in safe condition. As the track settles, the heavy shims must be removed and thinner ones substituted, until the rail again rests directly on the ties. Warm rains tend to cause uniform settlement, but clear weather and warm south winds draw the frost first from the south side of east and west lines and, generally, from the west side of lines running north and south. As a result, the track may settle badly out of level. In fact, cases have occurred where shimming of one rail has been necessary as the frost left this rail, but remained for a time under the opposite one.

Trackmen should make sure that the track is kept level, and to the best surface practicable until it can be surfaced. They should keep the rail braced as the shims

are being removed, with the same care as when they were first applied. In fact, every precaution that is necessary in shimming is required during removal, while careful watchfulness is doubly important.

Needs Watchful Attention

By W. R. GARRETT

Yard Foreman, Chicago, Burlington & Quincy, Pacific Junction, Iowa

Where heavy shims have been necessary, the track should be watched closely as soon as the frost begins to leave the ground. As the track settles, the same methods and precautions should be used as when making the original application. In other words, the thicker shims should be removed and thinner ones substituted until full settlement has taken place, after which the track should be smoothed up by raising and tamping. Ordinarily, where thin shims have been applied in the first instance, and the frost has gone out sufficiently to make resurfacing desirable across the low spots, the work can be done by raising and tamping. Frost always leaves the surface first, the ballast and ground thawing out progressively from the surface, so that when it has left down to the bottom of the ties the track can be worked.

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Stone or Concrete Curb?

What are the relative advantages and disadvantages of stone and concrete curbs for brick platforms? What advantages, if any, do precast concrete curbs possess over cast-in-place concrete curbs ?

Uses Concrete Curbs Only

By F. R. JUDD

Engineer of Buildings, Illinois Central, Chicago

We have not used any kind of stone curbs in our platforms for some time. If stone curbs are used, it is generally a case of choosing between granite and some form of limestone. The cost of granite is prohibitive in our territory, and we find no advantage in limestone as compared with concrete for this purpose. For these reasons, it is a recognized practice on the Illinois Central to use concrete curbs for all brick platforms.

As between cast-in-place and precast concrete curbs, the relative advantages will usually depend upon the traffic conditions, as they will have a direct bearing on the cost of the curb. The cast-in-place curb is more stable, while the precast type can be more readily removed and possesses a certain salvage value. When inviting bids we usually request the contractor to submit prices on both types and then determine the types to be used on the basis of cost. We also give consideration to probable changes in the facilities, which might make the precast type more desirable.

Prefers Cast-in-Place Curbs

By General Inspector of Buildings

We have used all three of the types mentioned, and as a result of our experience, we prefer the cast-in-place concrete curb, except in special cases. Granite does not deteriorate, wears well and is not easily damaged, but the cost is relatively high. Some sandstones give excellent service, while others do not. Most limestones are too soft and are easily damaged, while some of them show laminations after they are installed and others do not weather well. Stone curbs can be alined with relative case, but because of their small base, do not remain stable and tend to tip away from the platform.

There are only two advantages in precast concrete curbs as compared with the cast-in-place type. They can be made somewhat cheaper in a central casting yard, but they are too heavy for easy handling and are difficult to set in alinement, while they are somewhat less stable than the cast-in-place type. They require less time for installation, however, and it may be advantageous to use them where time is an important element of the construction.

Cast-in-place curb can be given a perfect alinement, kept at the proper grade and will remain stable. I attach little importance to salvage, since permanent platforms should not be constructed where there is a strong probability of changes which will require their removal. We are no longer constructing our platforms of brick, all of our recent ones being of concrete. An advantage of the cast-in-place curb is that, if set at the proper elevation, it can later be utilized as a part of the concrete platform which replaces the brick.

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Tamping Loose Ties

When track is not out of surface, but some of the ties are loose, can these ties be tamped satisfactorily with power tampers without first giving the track a slight raise? Do the character and size of the ballast make any difference? Why ?

Can Be Done Satisfactorily

By WILLIAM H. ARMSTRONG

Manager Tie-Tamper Sales, Ingersoll-Rand, Inc., New York.

It is my opinion that loose ties can be tamped satisfactorily with the reciprocating-blow type of power tampers without first giving the track a slight raise. The reason for this is that the power tampers, working opposite each other, will drive the ballast under the ties until the void is filled completely and the tie is brought up firmly against the base of rail. The character and size of the ballast make no difference, provided the proper type and size of tamping bars are used with the power tampers. In expressing this opinion I have in mind particularly the percussion type of pneumatic tie tamper.

Determined by Characteristics of Ballast

By LAWRENCE A. LUTHER,

San Francisco, Cal.

The results of spot tamping with mechanical tampers without a preliminary raise, depend in large part on the characteristics of the ballast and its condition in the bed beneath the ties. The driving of coarse stone or slag into voids which are measured in small fractions of an inch cannot be accomplished unless the ballast can be moved en masse toward the center of the ties. Experienced trackmen know that pick tamping of slightly loose ties forces only a narrow wedge of material under the edges of the ties, which holds only temporarily, while the bottom and edge of the tie are damaged by the abrasion of the pick and the small area of the bearing.

Mechanical tampers are being used widely with success for tightening loose ties and for spot tamping in routine maintenance. Among the outstanding advantages of this equipment in this service are its ability to force the ballast to the center of the tie, thus compacting it more thoroughly and uniformly. At the same time there is

less tendency to pulverize the material and, if the tamper is used properly, it does not damage or abrade the tie. By moving the ballast practically en masse, this method of tamping insures that the small voids will be filled and the tie given a solid bearing. Successful use of this equipment for this type of tamping depends, however, on a judicious selection of bars, a relatively thin bar usually being required for best results.

A Slight Raise Is Preferred

By HENRY BECKER

Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

If there are loose ties in track that is not actually out of surface, a slight raise is desirable, even though the ties can be well-tightened without making the raise. Where there are a few loose ties it is reasonably certain that others are approaching this condition. If only the loose ties are tamped, the bearing will not be uniform and the track will ride "hard". A light raise will give the opportunity to tamp every tie over the area affected, the tamping will be uniform and the track will ride smooth.

The character and size of the ballast have much influence on work of this kind. Spot tamping is always difficult in coarse stone or washed gravel, while it can be accomplished more readily in the finer grades of ballast, chatts for example. A light running surface can be given to track ballasted with chatts, with a minimum of effort, while it may scarcely be possible to do so with coarse stone.

A Raise Is not Necessary

By G. W. MORROW

Representative, Ingersoll-Rand, Inc., Chicago

It is not absolutely necessary to give the track a slight raise in order to tamp loose ties, if power tampers of the reciprocating-blow type are used. By working two tampers opposite each other, the action of the tools will break down the hard walls, which form a sort of a pan, at the edge of the tie. They will then follow through into the void under the tie, loosening the top of the old bed enough to allow for some drainage. Pulling the tool back at intervals will allow ballast to fall into position to be driven quickly into the void by the rapid succession of light blows given by the tool. The tie is thus tamped thoroughly with ballast that is uniformly compacted, this operation taking less than a minute for each section of the tie that is tamped.

If the ties have been loose for some time, and drainage is none too good, hard walls are also likely to be formed at the end of the ties. For this reason, the tamping should continue into the shoulder at least two inches beyond the end of the tie to insure drainage. In expressing this opinion I have in mind particularly the pneumatic type of percussion tie tamper.

Slight Raise May Be Desirable

By L. L. ADAMS

Division Engineer, Louisville & Nashville, Evansville, Ind.

In nearly every case after track has been surfaced, a few loose ties will develop, usually at the joints. In general, this requires light tamping which can be done more economically by hand, since the track is not out of surface and only occasional ties demand attention. After the track has run a year or more, a large number of ties may be loose, and the labor required to tighten them may be excessive if done by hand, so that power tampers will be more economical. Under these circumstances, I think it would be better to give the track a slight raise and tamp every tie with the power tampers, even if the surface has remained satisfactory.

The size of the ballast is also a factor. If large, it is necessary either to make a raise or to select by hand the sizes that can be used for tightening the slightly loose ties. The latter is not practicable where power tampers are used. If the ballast runs small, the number of ties needing attention will govern, but if the number is great enough to make power tamping more economical, I think it would be better to give the track a light running surface.

A Difficult Question to Answer

By W. RAMBO

Roadmaster, Missouri Pacific, St. Louis, Mo.

This is a difficult question to answer, because, while it might be possible to tamp as suggested, I do not think it is generally practicable to do so. From my own experience and observation, I do not believe that loose ties in track that is not out of surface can be tamped satisfactorily with power tampers, unless the track is given a slight raise. This is particularly true for coarse ballast. Tamping in this manner may be satisfactory with fine ballast, such as chatts, although I do not believe that the results will justify the cost of using power equipment for such light work.

There is a further and very practical consideration. If foremen are allowed to tamp ties without raising the track, they are likely to fall into bad habits and some of them will soon resort to the practice of tamping their ties without raising spots that are actually low.

Improves Water Supply

(Continued from page 260)

Texas & Pacific relatively new and in service an insufficient length of time to permit the determination of their real economy and worth, detailed results obtained from the extensive improvements on this road as a whole are not available at this time. However, it is definitely known that large economies are being effected in many instances, being reflected in reduced water service forces, reduced pumping costs and the increased life of boiler flues.

In 1915, the average cost of pumping water on the system as a whole was 18 cents per 1,000 gal., whereas during the last 15 years, this figure has been gradually reduced until today it is only about 8 cents per 1,000 gal. At Van Horn, where semi- and full Diesel engines and deep well pumps replaced old steam pumping equipment, as described earlier in this article, the cost of water was cut from 67 cents per 1,000 gal. to 8 cents.

Since the introduction of water treatment on the road, locomotive boiler flue life has been increased from an average of about 50,000 miles to approximately 100,000 miles, and freight engines now operate over 350-mile divisions whereas 150-miles was the limit formerly.

At Fort Worth, before a lime-soda ash plant and an effective settling basin were provided to treat the hard river water used, the stationary boilers were usually run on 20 to 30-day periods. Since the provision of the treating facilities, the run of the boilers has been extended to 60 days, and at the end of these periods, the amount of incrusting scale found is only about 15 per cent of what was found formerly in the shorter periods.

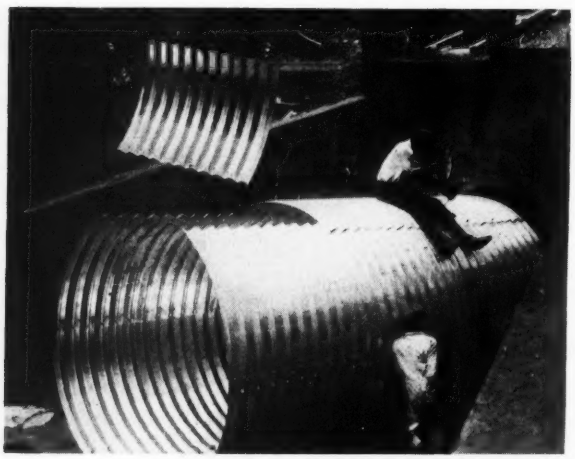
All of the water service improvements on the Texas & Pacific have been planned and carried out under the direction of E. F. Mitchell, chief engineer, and R. L. Holmes, engineer water supply.

New and Improved Devices

Multi-Plate Pipe Developed by Armco

MULTI-PLATE pipe, a new form of corrugated iron pipe that is made in sections and assembled in the field instead of being manufactured by the usual shop fabrication methods, has been developed by the Armco Culvert Manufacturers Association, Middletown, Ohio. This plate is similar in appearance to the usual corrugated metal pipe except that it is made of heavy plates strengthened with larger corrugations and is assembled in the field by bolting the plates together.

The ingot iron plates have corrugations 6 in. from crest to crest and 1½ in. in depth. The plates are match-punched, formed or curved to the desired shape, and galvanized before shipment. When shipped the plates are nested to reduce space requirements. For erection 6, 7, 8 or more plates are bolted together to form 90, 105, 120-in. diameter or larger pipe, respectively. The gage of the plates can be varied according to the diameter.

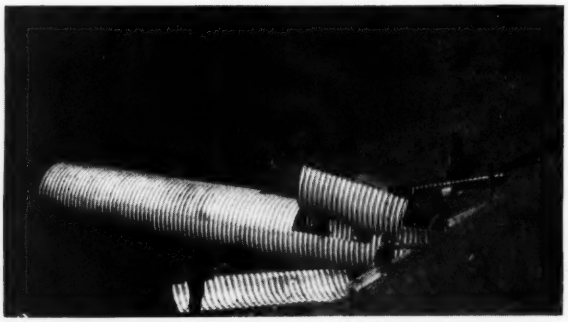


Installing a 90-in. Multi-Plate Pipe to Replace a Failed Arch

When bolting the plates together, the circumferential joints are staggered so that continuous pipe in any multiple of five feet can be obtained without a circumferential seam. The plates come in standard lengths of 10, 7½ and 5 ft.

With the use of this pipe, it is pointed out that a balanced design is obtained by using heavier plates in the bottom where the wear occurs. In addition, the pipe is designed for durability and the character of its design permits of economical production and erection.

A number of installations of this pipe have already been made under railroad embankments. One of these, a 105-in. pipe 30 ft. long, was installed to replace an I-beam bridge that failed under two gondolas loaded with gravel. Four men erected the pipe in 10 hr. working time and traffic was resumed 36 hr. after the plates arrived on the job. The installation required 1,000 cu. yd. of backfill. In another instance, an installation of Multi-Plate pipe, 90 in. in diameter and 125 ft. long, was used to replace a failed arch bridge. In this installation, the pipe was built up of No. 8 gage plates except for the invert which was of No. 5 gage metal.



Assembling 75 ft. of 75-in. Multi-Plate Pipe for Installation Under a Railroad Embankment

A New Gaging Tool

THE Woodings Forge & Tool Company, Verona, Pa., has developed and put on the market a new, lightweight, one-man tool for use in pulling and holding rails to gage during rail-renewal or regaging operations. It is said that its use greatly facilitates this operation compared with the common use of bars or picks, and also eliminates completely the destructive effect on the ties that results from the use of a pick. The new tool, which is known as the Woodings gaging tool, consists essentially of a tension bar or pipe with a suitable rail-hold casting on one end and a special, lever-receiving casting on the other, and depends only upon the aid of a common crowbar or other similar bar for its use.

The rail-holding casting merely provides a hold over the outside of the line rail when the tool is laid across the track in gaging position, while the bar-holding casting is a flat, specially designed piece of suitable length which rests on top of the opposite rail and has a longitudinal slot through which a bar may be inserted in a vertical or nearly vertical position. As the outer end of this casting forms a bearing or fulcrum for the bar which has its lower end in contact with the base of the rail, and the line rail forms an anchor for the tool, a reasonable pull on the top of the bar is all that is necessary to

The New Gaging Tool in Use

force the rail inward and hold it in the desired position until spikes are set.

The tool is made of double-strength pipe and steel castings, and is adequate for use with all rail sections from 60 lb. to 132 lb. It is insulated thoroughly and weighs only 20 lb.

New Waterproofing Effective Under Considerable Head

A RELATIVELY new concrete waterproofing compound in this country, known as Sika and designed for use in a wide range of waterproofing work, even to the stopping of the flow of water under considerable pressure, is being distributed by the American Sika Corporation, New York. This compound has been used extensively in Europe and more recently has been applied in this country by a considerable number of contractors.

Sika, which is compounded in five different grades to suit best the different types of waterproofing problems generally encountered, comes in either liquid or paste form and is supplied in containers ranging in size from 1-gal. cans to 50-gal. drums. Its main features are that it produces a dense quick-setting concrete with early high strength, which will adhere readily to steel or to new or old concrete and stop the flow of water, even if under considerable pressure. It is said that when used in the proper proportions, it will give portland cement mortar a tensile strength of 100 lb. per sq. in. and a compressive strength of 5,000 lb. per sq. in. in one hour, and that it has sealed concrete effectively against water pressures due to heads exceeding 1,500 ft., without removing the pressure.

In its use, Sika is mixed either alone with portland cement, or with the cement mixing water in accordance with specific instructions depending upon the character of work to be done. When used undiluted, which is done when stopping the flow of water under pressure, the portland cement sets up in as short a time as 10 seconds. This short interval is extended to any length of time desired by diluting the Sika with water.

When waterproofing new concrete as prepared, a normal setting Sika is added to the mixing water as an ingredient in the concrete in the proportions of 1 part of Sika to 25 parts of water by volume. When waterproofing damp spots on existing work due to the porosity of the concrete, the spots are covered with a cement mortar actuated by a normal setting Sika. When treating portions of old concrete through which water is percolating or over which water is running, a cement and sand mortar activated by one of the quick-setting grades of Sika is applied to stop the flow of water, and then the entire surface is covered with a cement mortar containing a slower acting grade of Sika.

Stopping the flow of a considerable quantity of water under a considerable head, especially when issuing from a large hole or crack, is the most difficult of the problems encountered, but this is done by mixing the most active grade of Sika, undiluted, with cement.

A New Portable Compressor of Large Capacity

THE Gardner-Denver Company, Quincy, Ill., has recently added to its line of portable railroad compressors a new unit having a capacity of 360 cu. ft. of free air per minute and capable of handling 16 tie-tamping tools. This compressor was developed with a view to meeting the needs of railroad maintenance departments for an economical and dependable outfit of large capacity.

Both the compressor and engine are said to be of the latest automotive design, and are featured by force-feed lubrication with filtered oil, counter-balanced three-bearing crankshafts, and an efficient water-cooling system. The compressor is of the 60-deg. V-type of construction with four cylinders, which permits the use of light-

The New Gardner-Denver Portable Air Compressor

weight reciprocating parts and which is said to result in a smoothly running compressor that is practically free from vibration, owing to the small inertia effect of the balanced parts, the opposed cylinder construction and the three-bearing crankshaft. The outfit is equipped with an air after-cooler for reducing the temperature of the air after it leaves the receiver and before it enters the hose.

The compressor and engine are mounted on a one-piece cast-steel frame and are connected by means of a flexible flywheel coupling, which is claimed to require no oiling or greasing. The car assembly consists of heavy channel steel members and is fitted with manually-operated lifting jacks and transverse runoff wheels for insuring the removal of the car from the rails in a quick and dependable manner. The cast-steel flanged wheels are secured to the axles by a taper fit, and revolve in roller bearings with inner and outer races.

This equipment is offered in either self-propelled or non-self-propelled types. In the former type the propelling mechanism consists of a double-acting air motor, connected by means of a roller chain and sprockets to the rear axle of the car. The air motor is said to be sufficiently powerful to propel the unit up a steep grade, and is reported to be both simple and dependable in operation. The motor is controlled by a flat, self-seating valve, which is connected to a throttle or operating lever.

What Our Readers Think

A Common Outlet and Inlet Pipe

To the Editor:

In the What's the Answer columns of the February issue, you published two replies to a question relative to the advantages and disadvantages of a common inlet and outlet pipe for a water-service tank. In each of these replies, statements were made to the effect that a float valve cannot be used where one pipe serves the common purpose of inlet and outlet. I cannot agree with these statements and do not believe that they should be allowed to stand, because many installations of this kind are in very satisfactory operation; furthermore, it seems unfair to the manufacturers of water-service equipment to permit these false impressions to prevail.

A situation of this kind can be taken care of by having the common pipe, which serves both as an inlet and outlet, extend about 24 in. above the floor of the service tank, or, at a minimum, to a sufficient height to permit a tee fitting to be placed just above the floor line. The regulation float valve, which closes when the tank is full, is then placed on the top end of the line and a horizontal-swing check valve is placed in the side outlet of the tee fitting. With this arrangeemnt, when water flows into the tank, the check valve is closed and held against its seat. After the tank has been filled, however, and the float valve closed, any reduction of the pressure in the common pipe will open the check valve. Thus, if water is drawn from the supply mains, the pressure against the check valve is released and it opens, permitting a free flow of water to the point of use. There are also on the market combination float and outlet valves designed for this purpose.

In one type which is commonly used, water enters the tank in the usual way, flowing out through openings in the side of the valve body. At the same time it enters a cap space above the regular valve, where it closes an opening in the top of the cap by forcing an auxiliary valve into place. When the tank is filled, the float automatically closes the side opening in the regular valve and the auxiliary valve also remains closed. When water is drawn from the riser pipe, the pressure against the auxiliary valve is released and the water is drawn out through this top valve opening. As the float settles, the side openings begin to operate to release the water. Where automatic pumping equipment is in use, the lowering of the float again starts the supply from the pump.

There are frequent cases where, because of the expense involved or for other reasons, it is quite impracticable to have both an inlet and an outlet pipe. Frequently, the pumping station is necessarily at a considerable distance from the storage tank and the tanks may also serve widely separated facilities, thus making it essential to have inlet and outlet arrangements common to one pipe.

Under these conditions, water hammer is a very important matter and water columns must be selected with the greatest care. Fortunately the manufacturers have also met this condition with designs which, while providing a maximum flow of 3,000 to 4,000 g.p.m., close off the flow so gently that the jar from water hammer is usually negligible. While a storage tank will absorb some of the shock of water hammer, the jar caused by the too rapid closing of a water column valve is transmitted in every direction that the water may come from and in some cases has had an effect at the pumping plant sufficiently serious to warrant the placing of an auxiliary relief valve at that point.

The stirring up of the tank sediment by reason of water entering and leaving through a common pipe should not be serious if the tank is cleaned at sufficiently frequent intervals. The inlet pipe should usually project approximately 12 to 18 in. above the floor of the tank, thus leaving reasonable space for sediment to collect. In colder climates, this will also be high enough above the tank floor so that ice formed across the bottom may not interfere with the operation of the outlet valve.

Water Service Engineer.

New Books

General Handbook

GENERAL ENGINEERING HANDBOOK, by Charles Edward O'Rourke, assistant professor of structural engineering, Cornell University, editor-in-chief. 921 pages, illustrated, 8 in. by 5 in. Bound in flexible fabricoid. Published by McGraw-Hill Book Company of New York. Price $4.

This handbook differs from those previously offered in that it endeavors to present what might be termed an outline of civil, mechanical and electrical engineering within the compass of less than 1,000 pages. It represents the work of the editor and 29 associate editors, who, with three exceptions, are professors in engineering colleges. The subject matter is necessarily presented in concentrated form and implies a general knowledge of engineering theory and practice on the part of the user, the primary purpose being to provide a ready source of information to the engineer concerning divisions of the profession other than the one with which he is thoroughly conversant. The book is divided into 31 sections, such chapter headings as Hydraulics, Surveying, Foundations, Refrigeration, Welding, Power Transmission and Machine Design being indicative of the wide range of subjects covered.

New Edition of Old Book

RAILROAD CONSTRUCTION, Theory and Practice, (Ninth Edition), by Walter Loring Webb. 925 pages. Illustrated, 7 in. by 4½ in. Bound in flexible Fabricoid. Published by John Wiley & Sons, New York. Price $6.

In form, this edition of this well-known hand book is like its predecessors, embracing 700 pages of text and 242 pages of mathematical tables, although the author's preface states that a very large part of the edition is new. There is evidence of this in the extent to which carefully selected material has been abstracted from recent proceedings of the American Railway Engineering Association. There are also large portions of the book, for example the chapters on Railroad Surveying, Alinement and those devoted to the economics of railway construction, which deal with subject matter in which there has been little change through the years. However, other parts have not been brought fully up to date. Space is given to wood preserving processes that have been obsolete for a quarter of a century, but no reference is made to creosote-petroleum mixture treatment. The chapter on Culverts gives a page to vitrified tile pipe, but disposes of concrete pipe in four lines and fails to mention corrugated metal at all. The failure to omit or replace illustrations depicting standards of construction now obsolete creates an unfavorable impression of the book that is unwarranted in the light of its real merits.

News of the Month . . .

Six-Hour Day Resolution Passes Congress

On March 11, the Senate passed without discussion a resolution previously passed by the House of Representatives directing the Interstate Commerce Commission to investigate the effect upon operation, service and expenses, of applying the principle of the six-hour day in railway employment. The resolution was signed by the President on March 15.

Atterbury Optimistic

General W. W. Atterbury, president of the Pennsylvania, expressed the belief that "we are justified in looking for signs of the beginning of a healthy recovery," at the second annual dinner of the Transportation Club of the New York zone of that road, at the Hotel Pennsylvania, New York, on February 29. "Recent developments point definitely in the direction of improvement," said General Atterbury. "I am greatly pleased with the measures taken at Washington to strengthen our banks and general financial conditions, to release credit to provide sound assistance to our railroads in going ahead with improvements and meeting obligations. Of similar character are the steps being taken towards dealing with the problem of unregulated and unfair competition against the railroads, and improving regulation of the railroads themselves. Railroad employees have demonstrated their own understanding of existing conditions and necessities in a signal manner and I commend them most heartily for it."

Railway Income for January Lower

The net railway operating income of the Class I railroads in January amounted to $11,713,611, which was at the annual rate of return of 0.8 per cent on their property investment, as compared with net railway operating income of $34,341,414, or 2.34 per cent, in January, 1931. Operating revenues in January amounted to $275,370,629, as against $366,040,940 in January, 1931, a reduction of 24.8 per cent, while operating expenses totaled $229,548,119, as compared with $294,152,807, a reduction of 22 per cent. Taxes paid in January by the Class I railroads amounted to $24,406,699, a reduction of $2,524,287, or 9.4 per cent, below those for the same month last year. Eighty Class I railroads operated at a deficit in January, of which 28 were in the Eastern district, 17 in the Southern district and 35 in the Western district.

End Hearings on Four-System Plan

On March 5, four weeks of hearings before Chairman Claude R. Porter and Examiner Koch of the Interstate Commerce Commission were concluded on the application of the principal eastern railroads for a modification of the commission's consolidation plan to provide for four eastern systems instead of five. Briefs are to be filed by April 18, and it is expected that oral arguments before the commission will be held beginning about April 25. The applicants in this case, around which the four systems will be built if the plan is approved, are, the Pennsylvania, the New York Central, the Baltimore & Ohio and the Chesapeake & Ohio-Nickel Plate system.

An Impressive Safety Record

During the year 1931, railroads of the United States and Canada transported more than 330,000,000 lb. of commercial explosives, including dynamite, black blasting powder and permissible explosives, without a personal injury or the loss of a life and with no property damage, according to the annual report of the chief inspector of the bureau for the safe transportation of explosives and other dangerous articles. This record equals the perfect record that was established in 1930. During the last five years more than 2,000,000,000 lb. of commercial explosives have been transported over the railroads of the United States and Canada without the loss of a life and with a total money damage amounting to only $213.

California State Employees Told to Ride Trains

As a measure of economy in both time and money, the department of finance of the state of California has directed all state officers and employees to travel by train when practicable. It is pointed out that the use of automobiles for traveling over long distances paralleling railroads is costing the state many thousands of dollars per year, of which a considerable portion could be saved if state officers and employees would use train service. All department heads are told to instruct their officers and employees that the use of automobiles to make long trips paralleling railroads must be discontinued. Comparisons of the relative cost of train and automobile travel are made. For instance, between Sacramento and San Francisco the round trip mileage is 190 and the train fare is $3.60, while the cost of the round trip by state owned automobile at 4.6 a mile is $12.44, and the cost of the trip by private automobile on the allowance of 6 cents a mile is $14.20. The comparisons show that travel by train between other points in California will effect economies in proportion as compared with highway travel.

January Results of Emergency Freight Rate Increase

Reports of railroad revenues and expenses to the Interstate Commerce Commission for January, which included a separate statement of the amount received by each road from the temporary emergency increase in freight rates recently authorized by the commission, indicate that about $4,000,000 of extra revenue was obtained from this source during the month. Some of the roads which reported the largest amounts obtained from this source, together with the amounts reported, are as follows: Pennsylvania, $570,217; New York Central, $460,212; Baltimore & Ohio, $235,000; Chesapeake & Ohio, $151,191; Illinois Central, $136,340; Erie, $112,559; and the Reading, $97,217.

Professor H. E. Boardman Dies

Howard Edward Boardman, Dudley professor of railroad engineering in the graduate school of Yale University, New Haven, Conn., died of pneumonia at his home in New Haven on February 28. Death came to Mr. Boardman before he had had an opportunity to commence actual instruction in his course, as he was appointed to the professorship on July 1, 1931, and had devoted the first few months of his incumbency to a thorough study of the present railroad situation, to which end he had been in constant touch with railroad executives throughout the country. The professorship which Mr. Boardman held was created by an endowment fund established by the late Lucy B. Dudley and by an additional bequest of her husband, the late Doctor P. H. Dudley, who for many years was

consulting engineer for the New York Central and a recognized authority on steel rails. Professor Boardman was a graduate of the Sheffield Scientific School of Yale University and had a long record of broad practical experience in the railroad engineering field. He entered railway service with the Pennsylvania and later served in responsible engineering positions with the Missouri Pacific, the Buenos Aires Western, the New York Central and the Boston & Maine.

48 Roads Ask 356 Millions of Finance Corporation

Up to March 22, 48 railroads had applied to the Reconstruction Finance Corporation for loans amounting to a total of $356,000,000. For the most part these involved requests for loans to meet interest, maturities, taxes and bills, practically the only requests for improvement loans being those of the Pennsylvania, for $55,000,000, and of the New York Central, for $7,000,000. Of these requests for loans the Interstate Commerce Commission has approved 17, to 15 roads, for a total of about $54,000,000. Although the Finance Corporation has announced loans to only six roads, it is understood that it has granted practically all those approved by the commission.

Recommends Reduction in I. C. C. Appropriation

In its report on the independent offices appropriation bill, the House of Representatives committee on appropriations recommended a reduction in the appropriation for the work of the Interstate Commerce Commission for the fiscal year ending June 30, 1933, to $7,228,179, which is $2,184,294 less than the appropriation for 1932, and $1,533,231 less than the budget bureau estimate. With reference to the reduction as compared with the budget estimate, the committee explained that $1,483,321 represents the elimination of work occasioned by the recapture provisions of the law in view of the belief of the committee that "recapture will be retro-actively repealed at this session of Congress, since the legislation for the repeal has the full endorsement of the Interstate Commerce Commission and there has not developed any substantial opposition to the repeal."

New Pension Bill Introduced in Congress

A plan for a system of compulsory retirement insurance for railway employees, to be administered by a government board and supported by equal contributions by the railway companies and their employees, is proposed in a bill drafted by a committee of the Railway Labor Executives' Association, which was introduced in Congress on March 3. If adopted, this plan would take the place of the pension system now maintained by many railroads. Under it, the contributions made by the railroads and their employees would be sufficient to yield employees on retirement from service an annuity equal to two per cent of their average annual compensation multiplied by the number of years of their contributory service. The bill would create a Railway Employees' Retirement Insurance Board, composed of five members appointed by the president; two on nominations by the employees, two on nominations by the carriers and a fifth appointed without recommendation by either party on the basis of "mature experience in financial and insurance matters." The bill provides for step-rate contributions to the employees' retirement insurance fund, beginning with two per cent for employees of 21 to 34 years of age and increasing gradually to five per cent for employees of 50 years and over. Employees would be eligible for retirement on attaining the age of 65 years or on completion of 30 years of contributory service.

Safety Section, A. R. A., Joins National Safety Council

Following action taken by the Committee of Direction of the American Railway Association last October and its approval by President R. H. Aishton on February 26, the Safety Section, A. R. A., is to become the Steam Railroad Section of the National Safety Council and will hold its annual meeting as a part of the annual congress of the council. However, the Safety Section retains its name, rights, privileges, obligations and organization as a section of the American Railway Association. This action has been taken for the purpose of eliminating duplication of effort and decreasing expenses. It is described as an emergency arrangement to be effective for two years from March 1, 1932, and to be subject to review the end of that period. The annual meeting of the Safety Section, heretofore held in the spring, will be held this year on October 4, 5 and 6 at Washington, D. C., in connection with the annual meeting of the National Safety Council.

Railroad Payroll Reduced 813 Millions in Two Years

The total railroad payroll for 1931 was $813,687,403 below that for the year 1929, and the number of employees in December, 1931, was 625,625 less than the number in the peak month of August, 1929, according to a summary of railway wage statistics for the year, issued by the Interstate Commerce Commission, based on a consolidation of the twelve monthly summaries for the year. The average number of employees for 1931, based on the 12 monthly counts, was 1,278,175, a decrease of 232,513, or 15.39 per cent, compared with the number for 1930 and a decrease of 408,594, or 24.2 per cent as compared with 1929. The total compensation for 1931 was $2,127,181,287, a reduction of $463,093,556 below that for 1930. The number of hours (straight time actually worked plus overtime paid for) for the year, divided by the average number of persons reported as employed at the middle of each month, was 2,298 for 1931, compared with 2,511 for 1929. This comparison does not take into consideration those furloughed employees nor represented among the employees in the mid-month count.

Association News

Bridge and Building Association

Thirty members of the association gathered for lunch in Chicago on March 15 during the convention of the A. R. E. A., at which time the present status of the work of the organization and plans for the convention next fall were discussed.

Roadmasters Association

The Executive committee has authorized the appointment of two new committees, supplementing the five which prepared reports for the meeting which was to have been held last September. The new committees will report on (1) Time Leaks in Maintenance Work and (2) The Handling and Disposition of Used Materials.

Metropolitan Track Supervisors' Club

The next meeting of the Metropolitan Track Supervisors' Club will be held on April 21 at the usual place of meeting, Keen's Chop House, 72 West Thirty-sixth street, New York. Following dinner, which will be served at 6:30 p. m., a paper will be presented on the Field Maintenance of Work Equipment. This paper is being prepared by a committee of which E. H. Mills, inspector, New York Central, is chairman.

Wood Preservers Association

At an informal meeting of members of the Executive committee at Chicago on March 16, it was decided to hold a summer meeting of the Executive committee and of other committees, jointly with the Committee on Wood Preservation of the A. R. E. A., at Washington, D. C., in May or June, at which time, after the conclusion of the committee work, opportunity will be afforded to visit the laboratories of the United States Bureau of Standards and observe the work on investigations of timber.

American Railway Engineering Association

March 13, 14 and 15, 1933, were chosen as the dates for the thirty-fourth annual convention of the association at the meeting of the new board of direction which was held immediately after the close of the thirty-third convention on March 16. This definitely provides for a three-day convention with the proviso that it may be cut to two days if conditions again make such action advisable. The work of the association was also definitely organized for the coming year, with the appointment of the board's seven standing committees, the chairmen of which are as follows: Outline of work, J. C. Irwin, valuation engineer, Boston & Albany; Personnel of committees, J. E. Armstrong, assistant chief engineer, Canadian Pacific; Publications, G. W.

Harris, chief engineer, Atchison, Topeka & Santa Fe System; Manual, G. D. Brooke, vice president, Chesapeake & Ohio; Finance, E. A. Hadley, chief engineer, Missouri Pacific; Library, C. R. Knowles, Illinois Central; and Membership, D. J. Brumley, chief engineer, Chicago terminal improvements, Illinois Central.

Maintenance of Way Club

Rail Flaws and Their Detection was the subject for discussion at a joint meeting of the Maintenance of Way Club with the Western Railway Club and the American Railway Engineering Association on Monday evening, March 14, at the Hotel Sherman, Chicago, with an attendance of about 250. The principal speaker was C. B. Bronson, assistant inspecting engineer, New York Central Lines, who gave an illustrated talk on the detection of rail flaws and described the New York Central's new detector car. Following the conclusion of his remarks, motion pictures of the detector-car operation were presented and explained by C. W. Gennet, vice-president of the Sperry Rail Service Corporation.

National Railway Appliances Association

The National Railway Appliances Association will hold an exhibit at Chicago in March, 1933, simultaneously with the convention of the American Railway Engineering Association, according to an announcement made at the annual meeting of the N. R. A. A. at Chicago on March 14. This meeting was also the occasion of the election of officers for the ensuing year, which are as follows: President, Frank McAllister, president of the Kalamazoo Railway Supply Company, Kalamazoo, Mich.; vice-president, Alex Chapman, district sales agent of the Rail Joint Company, Chicago; secretary-treasurer, C. W. Kelly, re-elected. Four directors were elected, two for a term of three years and two to fill vacancies of unexpired terms. E. E. Thulin, district manager of the Duff-Norton Manufacturing Company, Chicago, and W. Homer Hartz, president and treasurer of the Morden Frog & Crossing Works, Chicago, were elected for three years, while M. C. Beymer, secretary of the Oxweld Railroad Service Company, Chicago, was elected to serve the unexpired term of Alex Chapman for one year, and C. H. Wilson, in general charge of railroad sales of Fairbanks, Morse & Co., Chicago, to serve the unexpired term of P. H. Gilliland for two years.

Republic Electric Weld Line Pipe Casing.—This is the title of a 36-page booklet published by the Republic Steel Corporation, Youngstown, Ohio, which contains a detailed description of the process of manufacturing this pipe, from the rolling of the flat plate to the application of the priming coat. In addition, tables are presented which give information on the weight, diameter, wall thickness, threads and couplings and mill test standards of various sizes of pipe. The booklet is printed in three colors and is attractively illustrated.

Personal Mention

General

Albert N. Williams, general superintendent of the Minneapolis, St. Paul & Sault Ste. Marie, whose railway career includes service in both the engineering and maintenance of way departments, has been elected president of the Chicago & Western Indiana and the Belt Railway of Chicago, with headquarters at Chicago. Mr. Williams succeeds **Edward H. Lee,** retired, who formerly was chief engineer of these roads.

Mr. Williams was born on June 14, 1888, at Denver, Colo., and after graduating from Yale University entered railway service in June, 1906, as a rodman on the Denver, Northwestern & Pacific (now part of the Denver & Salt Lake). In September of the same year he became a machinist's apprentice on the Denver & Rio Grande and from 1907 to 1910 he was engaged in graduate work in the Sheffield Scientific School of Yale University, re-entering railway service in July, 1910, as a brakeman on the Union Pacific. Later, Mr. Williams served this road as a section foreman, extra-gang foreman, timekeeper and inspector of equipment. In 1912, he entered the service of the Missouri-Kansas-Texas as a superintendent and later

Albert N. Williams

served as a trainmaster on this road and the Chicago, Rock Island & Pacific. From 1917 to 1921 Mr. Williams was connected with the petroleum industry, but returned to railway service in May of the latter year as assistant general manager of the Midland Valley. Subsequently he was promoted to general manager, and in March, 1926, he went with the Soo Line, being appointed general superintendent with headquarters at Minneapolis, Minn., early in 1927.

Mr. Lee was born on January 29, 1863, at Dayton, Ohio. He attended Ohio State University from 1877 to 1879 and Wooster University during 1883 and 1884. He entered railway service in 1880 as a rodman on the Scioto Valley (now part of the Norfolk & Western), and subsequent to 1887, served on various roads including the New York, Chicago & St. Louis, the Wisconsin Central and the Union Pacific as an instrument man, assistant engineer and resident engineer. He then entered the service of the Elgin, Joliet & Eastern as office engineer, serving as chief engineer of that road from 1889

Edward H. Lee

to 1893. From the later date until 1897, Mr. Lee was engaged in private practice as engineer and superintendent for contractors and in charge of field work for the Sanitary District of Chicago. During 1898 he served as principal assistant engineer on joint track elevation at Sixteenth street, Chicago. In the same year he went with the Chicago & Western Indiana and the Belt Railway of Chicago, where he served as engineer and general roadmaster until 1905, when he was promoted to chief engineer of these roads. In 1915 Mr. Lee was further advanced to vice-president in addition to his duties as chief engineer. During the period of federal control, Mr. Lee acted as president, but resumed the position of vice-president and chief engineer on the return of the railroads to their owners, which position he held until 1927, when he was elected president of the C. & W. I. and the Belt Railway.

Engineering

The Connellsville, Pittsburgh and Pittsburgh Terminal divisions of the Baltimore & Ohio have been consolidated into one unit to be known as the Pittsburgh division, which in turn has been divided into two subdivisions, known as the Eastern and Western divisions. The territory of the former Connellsville division comprises the Eastern subdivision and the territory of the Pittsburgh and Pittsburgh Terminal divisions comprises the Western subdivision. **G. B. Farlow,** division engineer of the Pittsburgh division,

with headquarters at Pittsburgh, Pa., has been appointed to the same position on the Western subdivision of the Connellsville division, with headquarters at Connellsville, Pa. **J. L. Maher,** division engineer of the Connellsville division, has been appointed to that position on the Eastern subdivision, with headquarters as before at Connellsville.

F. W. Thompson, division engineer of the Illinois division of the Chicago, Rock Island & Pacific, with headquarters at Rock Island, Ill., has had his jurisdiction extended to include the Chicago Terminal division, and **D. Ruhl,** division engineer of the latter division, with headquarters at Chicago, has been assigned to other duties.

The jurisdiction of **B. H. Prater,** chief engineer of the Oregon Short Line, with headquarters at Salt Lake City, Utah, has been extended over engineering and maintenance matters on the Los Angeles & Salt Lake and Oregon-Washington Railroad & Navigation units of the Union Pacific System. **R. L. Adamson** and **S. Murray,** chief engineers of the L. A. & S. L. and the O.-W. R. R. & N., with headquarters at Los Angeles, Cal., and Portland, Ore., respectively, will continue in direct charge of such matters on these lines.

J. R. Watt, general roadmaster of the Louisville & Nashville, has been promoted to the newly-created position of engineer maintenance of way, with headquarters as before at Louisville, Ky., which position combines the duties of the general roadmaster and assistant engineer maintenance of way, following the retirement of **James F. Burns,** assistant engineer maintenance of way, as noted in the February issue. The positions of

J. R. Watt

general roadmaster and assistant engineer maintenance of way have been abolished. Mr. Watt has been connected with the engineering and maintenance of way departments of the Louisville & Nashville for more than 26 years. He was born on April 16, 1884, at Greenfield, Ohio, and attended Salem academy, South Salem, Ohio, and later the University of Ohio. He entered railway service in August, 1905, as a rodman on the Louisville division of the Louisville & Nashville. Until 1914, Mr. Watt served as instrumentman and assistant engineer on the Cumberland Valley and Louisville divisions, as assistant engineer at Birmingham, Ala., and for a short time in the chief engineer's office at Louisville. In that year he was promoted to roadmaster of the Nashville division, which position he held until 1917, when he was further advanced to general roadmaster, with headquarters at Louisville. He held this position continuously until his recent appointment as engineer maintenance of way, effective February 15.

In an adjustment and consolidation of territories on the Erie, the New York district has been combined with the Eastern district, which now comprises all of the territory east of Buffalo. The Salamanca and Bradford divisions, formerly in the Eastern district have been added to the Western district which extends from Hornell and Buffalo to Chicago. Furthermore, the Delaware division has been combined with the Susquehanna division, and the Jefferson division has been consolidated with the Wyoming division. The Meadville division, east of Meadville yard, and the Buffalo and Southwestern railroad have been consolidated with the Alleghany and Bradford divisions, while the Mahoning division has been extended to include Meadville yard and the Franklin-Oil City branch. In connection with these changes, **I. H. Schram,** engineer maintenance of way of the old Eastern district, with headquarters at Hornell, N. Y., has become engineer maintenance of way of the enlarged Eastern district, with headquarters at Jersey City, N. J. **B. Blowers,** division engineer of the old Susquehanna division, with headquarters at Hornell, has been made division engineer of the combined Susquehanna and Delaware divisions, with headquarters at Harnell, as before, and **R. T. Davis,** formerly division engineer of the Delaware and Jefferson divisions, with headquarters at Susquehanna, Pa., has been appointed assistant division engineer of the enlarged Susquehanna division, with headquarters at Hornell. **C. M. Lewis,** division engineer of the old Alleghany division, with headquarters at Salamanca, N. Y., has been appointed division engineer of the enlarged Alleghany division, including the old Meadville division, with headquarters as before at Salamanca. **O. N. Lackey,** division engineer of the old Meadville division, with headquarters at Meadville, Pa., has been appointed assistant division engineer of the enlarged Alleghany division, with headquarters at Salamanca.

Sherwood Williamson, roadmaster on the Cumberland Valley division of the Louisville & Nashville, with headquarters at Middlesboro, Ky., has been promoted to the newly-created position of division engineer at the same point, and the position of roadmaster has been abolished. Mr. Williamson has been connected in various capacities with the engineering and maintenance of way departments of the Louisville & Nashville for nearly 22 years. He was born in Newbern, Tenn., on September 21, 1888, and graduated from the University of Tennessee in 1910. Prior to his graduation, Mr. Williamson served for a time with a location party on the Southern. After leaving school, he entered the service of the Cincinnati, Hamilton & Dayton in May, 1910, on dock construction work at Toledo, Ohio. Several months later he entered the service of the L. & N. in the construction department where he served in various capacities until January, 1913, when he was appointed instrumentman on the Louisville division. A year later Mr. Williamson was sent to the chief

Sherwood Williamson

engineer's office as a draftsman. In 1916, he was promoted to assistant engineer on the Kentucky division (now the Cincinnati division) where he served until October, 1923. On that date he was appointed supervisor of construction on second-track work at Berea, Ky., which position he held until February, 1925, when he was further advanced to roadmaster on the Birmingham Mineral division with headquarters at Birmingham, Ala. Mr. Williamson was transferred to the Cumberland Valley division in November, 1926, where he served continuously until his recent promotion to division engineer.

Track

W. R. Keay has been appointed acting roadmaster of the Yellowstone district of the Utah division of the Oregon Short Line, with headquarters at Ashton, Idaho., succeeding **G. Hammock.**

J. J. McInerney has been appointed roadmaster on the Northern division of the Colorado & Southern, with headquarters at Denver, Colo., to succeed **I. J. Kilburn,** whose death is noted elsewhere in these columns.

G. C. Barnett, roadmaster on the Edmonton division of the Canadian National, with headquarters at Biggar, Sask., has been transferred to the Edson division, with headquarters at Edson, Alta., to succeed **W. G. Bryant,** who in turn has been transferred to Biggar.

T. B. Fulkerson, assistant on the engineer corps of the Panhandle division of the Pennsylvania, has been promoted to assistant supervisor of track on the Buffalo division, succeeding **J. W. Reed,** who has been transferred to the Pan-

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WORKS AND GENERAL OFFICES

VERONA, PENNA.

handle division. Mr. Reed succeeds **W. P. Geiser,** who has been advanced to supervisor of track on the Renovo division, with headquarters at Warren, Pa., to replace **M. C. Bitner.**

R. A. Bryson, assistant roadmaster on the Eastern Kentucky division of the Louisville & Nashville, with headquarters at Ravenna, Ky., has been promoted to roadmaster on the Nashville division, with headquarters at Nashville, Tenn., a newly-created position. The position of assistant roadmaster at Ravenna has been abolished.

F. E. Schaumberg, assistant roadmaster on the First subdivision of the Galena division of the Chicago & North Western, has been promoted to roadmaster of the Fourth subdivision of the Eastern division, with headquarters at Norfolk, Neb., to succeed **I. B. Lakin,** whose death is noted elsewhere in these columns.

R. F. Lechner, assistant supervisor of track on the Eastern division of the Minneapolis & St. Louis, with headquarters at Oskaloosa, Iowa, has been promoted to supervisor of track at that point, to succeed **Frank Svec,** whose death is noted elsewhere in these columns.

In connection with the consolidation of the Eastern and New York districts of the Erie, as noted elsewhere in these columns under Engineering, **R. M. Cunningham,** general roadmaster on the old Eastern district, with headquarters at Harnell, N. Y., has become general roadmaster of the enlarged Eastern district, with headquarters at Jersey City, N. J. **J. R. MacAsy,** general roadmaster on the New York district, with headquarters at Jersey City, has been appointed track supervisor, with headquarters at Paterson, N. J., succeeding **C. L. Connor,** who has been made supervisor on Subdivision 3 of the Buffalo division, at Warsaw, N. Y., succeeding **R. D. Livingston.**

Following a rearrangement of the roadmasters' territories on the St. Louis division of the Chicago, Rock Island & Pacific, **D. B. Griffin,** roadmaster, with headquarters at Little Rock, Ark., has had his headquarters moved to El Dorado, Ark., while **G. H. Carpenter,** roadmaster with headquarters at Fordyce, Ark., has been assigned to other duties and his territory distributed among other roadmasters. Following a similar rearrangement on the Iowa-Minnesota division, **J. E. O'Brien,** roadmaster with headquarters at Oskaloosa, Iowa, has been transferred to Des Moines, Iowa, succeeding **P. Moran,** who has been assigned to other duties. The position of roadmaster at Oskaloosa has been abolished.

Bridge and Building

Norman Rose, supervisor of bridges and buildings of the Portland division of the Southern Pacific, with headquarters at Portland, Ore., has retired, effective March 31. Mr. Rose was born in Pennsylvania on March 23, 1862, and entered the service of the Southern Pacific as a carpenter on May 18, 1896. Subsequently he was advanced through the positions of bridge and building foreman and engineering assistant, being appointed supervisor of bridges and buildings in 1909.

In connection with the consolidation of divisions on the Erie as noted elsewhere in these columns under Engineering, **Roy Pierce,** master carpenter on the Susquehanna division, with headquarters at Hornell, N. Y., has had his jurisdiction extended to include the old Delaware division and **John Gibson,** master carpenter on the Delaware and Jefferson divisions, with headquarters at Susquehanna, Pa., has been appointed assistant master carpenter of the enlarged Susquehanna division, with headquarters at Harnell. **M. G. Tribe,** master carpenter on the combined Alleghany and Meadville divisions, with headquarters as before at Salamanca, N. Y., and **L. H. Ramer,** master carpenter of the Meadville division, with headquarters at Meadville, Pa., has been appointed assistant master carpenter on the enlarged Alleghany division, with headquarters at Salamanca.

Obituary

P. B. Spencer, engineer structures of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., died on March 26, at the age of 50.

J. W. Keenan, assistant division engineer on the Pittsburgh division of the Pennsylvania, with headquarters at Pittsburgh, Pa., died on February 15.

Frank Svec, supervisor of track on the Minneapolis & St. Louis, with headquarters at Oskaloosa, Iowa, died on February 21.

I. J. Kilburn, roadmaster on the Northern division of the Colorado & Southern, with headquarters at Denver, Colo., died on March 12 at his home at that point.

T. W. Bratten, retired supervisor of bridges and buildings of the Western division of the Southern Pacific, died on February 4, at his home in Oakland, Cal., after a short illness.

I. B. Lakin, roadmaster on the Fourth subdivision of the Eastern division of the Chicago & North Western, with headquarters at Norfolk, Neb., died on February 28, at that point.

Wm. B. MacKenzie, who retired in 1914 as chief engineer of the Intercolonian Railway, died at Daytona, Fla., on March 16 after a short illness. Mr. MacKenzie was born on February 16, 1847, at Kenzieville, Pictou county, N. S., and studied engineering at Pictou Academy. He entered railway service in 1872, as an office assistant in the engineer's office of the Intercolonial at Halifax, N. S. In 1879, Mr. MacKenzie was promoted to assistant engineer, being further advanced to chief engineer, with headquarters at Moncton, N. B., in 1897.

Henning Fernstrom, who retired as chief engineer of the Virginian in 1927, died on February 26 at Norfolk, Va. From 1881 to 1885, he was employed in the engineering departments of various railways and served as an assistant engineer on the construction of a railroad bridge across the Mississippi river at St. Paul, Minn. From the latter date until 1900, he was chief engineer of the Chicago Great Western and its predecessors and, during the following year, served as chief engineer of the St. Joseph & Grand Island (now part of the Union Pacific System). In 1901, he became principal assistant engineer and later assistant chief engineer of the New York Central & Hudson River, which position he held until 1903, when he was promoted to chief engineer. In 1905, he resigned to become chief engineer of the Virginian.

George W. Boschke, chief engineer of the Southern Pacific, Pacific Lines, with headquarters at San Francisco, Cal., died on March 3 of pneumonia at the Southern Pacific hospital at that point. Mr. Boschke had been in charge of many important engineering projects during his professional career of 46 years. He was born on October 10, 1864, at Boston, Mass., and graduated from Wilson College, Wilmington, Cal., in 1886. Later in the same year, Mr. Boschke entered railway service as an assistant engineer on the Southern Pacific, in which capacity

George W. Boschke

he had charge of the construction of the company's lines in Texas and its steamship terminals at Galveston, Tex. In addition, with the permission of the Southern Pacific, he was engaged to take charge of the construction of the seawall at Galveston, following the hurricane and tidal wave disaster of 1900. In 1905, Mr. Boschke was appointed chief engineer of the Oregon Railroad & Navigation Company (then affiliated with the Southern Pacific and now part of the Oregon-Washington Railroad & Navigation Company), at Portland, Ore., and while holding this position he supervised the design and construction of the joint railroad bridge over the Willamette river at that point. He became associated with Twohy Bros., contractors, in 1914, and served with that firm until 1921, when he was appointed assistant chief engineer of the Southern Pacific. In May of the same year, Mr. Boschke was advanced to chief engineer, with headquarters at San Francisco, Cal., which position he held until his death.

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Supply Trade News

General

The Reed-Prentice Corporation, Worcester, Mass., has recently completed arrangements for the sale of its Wolf portable timber sawing machine in the Los Angeles (Cal.) territory by Harron, Rickard & McCone Co., Los Angeles.

The Inland Steel Company has recently placed in service a new continuous plate and strip sheet mill. This mill will produce plates from 3/16 in. to ½ in. in thickness and with a maximum width of 69 in. The continuous strip width varies from 24 in. to 66 in. depending upon gage and other requirements.

The Medusa Products Company, Cleveland, Ohio, has been organized as a subsidiary of the **Medusa Portland Cement Company,** and will function as the selling company for Medusa portland cement paint and Medusa floor coating and primer as well as the rustproof coatings and technical paints manufactured by the **Studebaker Chemical Company,** Elyria, Ohio.

The trustees' claims and rights to the tie plate patents of the **Railroad Supply Company,** which was recently sold to the **General Railway Signal Company** in receivership proceedings, have been released to the respective owners, **E. H. Bell** and **William S. Boyce,** who will continue in the tie plate business. Mr. Bell has organized the **Track Supply Company,** Buckingham building, Chicago, and Mr. Boyce is doing business under his own name with offices in the Straus building, 310 S. Michigan ave., Chicago.

Personal

R. L. Allardyce, general superintendent of the International Creosoting & Construction Company, died at his home in Texarkana, Tex., on February 27.

H. B. Kehoe, manager of **Gillis & Co.,** Chicago, has been elected president, to succeed **Alexander D. Gillis,** retired, who founded the company in 1892.

R. W. Cornelisen, assistant general sales manager of the **Lakewood Engineering Company,** Cleveland, Ohio, and the **Jaeger Machine Company,** Columbus, Ohio, has been appointed field sales manager for the **Northwest Engineering Company,** Chicago.

Joseph M. Brown has been appointed assistant general manager of the transportation and government division of the **Philip Carey Company,** the **American Hair & Felt Co.,** and the **Dry-Zero Corporation,** with headquarters in Chicago. **James D. Baker** has been appointed chief engineer and in addition, the following local representatives have been appointed: **George A. Secor,** St. Louis, Mo.; **C. H. Doty,** Minneapolis, Minn.; **D. D. Grassick,** Cleveland, Ohio; **D. R. Warfield,** Philadelphia, Pa.; **Arthur Worrall** (special eastern representative), New York and Philadelphia; **J. Dan Bowden,** Atlanta, Ga.; and **H. R. Poulson** and **A. C. Reemer,** Chicago.

J. S. Ullmann has been appointed Washington representative of **The DeVilbiss Company,** Toledo, Ohio, with headquarters at 4000 Cathedral avenue, Washington, D. C.

W. R. England of the St. Louis office of the **Truscon Steel Company,** Youngstown, Ohio, has been appointed assistant manager, railroad department, southwestern district, with headquarters at 1005 St. Louis Mart Building, St. Louis, Mo.

John T. Clancy, assistant manager of oil and gas-engine sales of the Worthington Pump & Machinery Corporation, Harrison, N. J., died suddenly of a heart attack on March 9, while lecturing at the Engineers' Club, New York City, before a meeting of the American Society of Mechanical Engineers.

The sale of railway equipment manufactured by the **Nordberg Manufacturing Company,** Milwaukee, Wis., and heretofore handled by the **R. H. Hyland Company** in the Chicago territory, is now being handled directly by the former company through its general sales representative, **W. W. Fitzpatrick.**

William A. Irvin, a vice-president of the **United States Steel Corporation,** has been elected president, to succeed **James A. Farrell,** who will retire on April 19. Mr. Irvin has been actively identified

William A. Irvin

with the manufacture of sheets and tin plate and also with the iron and steel industry for the past 36 years. He was born on December 7, 1873, at Indiana, Pa., and was educated in the public schools and the night courses of the Indiana State Normal School. In 1888, he entered the employ of the Pennsylvania railroad as a telegraph operator and later became a clerk and assistant freight and ticket agent. In 1895, he went with the P. H. Laufmann Company, Ltd., Apollo, Pa., where subsequently he became superintendent. When this company was taken over in 1900 by the American Sheet Steel Company, Mr. Irvin was transferred to the general offices at New York, and in 1904, when the American Sheet Steel Company was merged into the American Sheet & Tin Plate Company, he went to Pittsburgh as assistant to the operating vice-president of the new company, which position he held for 20 years. He then served as vice-president in charge of plant operations, with headquarters at Pittsburgh, until September, 1931, when he was elected a vice-president of the United States Steel Corporation.

Mr. Farrell was born at New Haven, Conn., on February 15, 1863. He has been connected with the iron and steel industry since he was 16, when he began work with the New Haven Wire Company, New Haven. In 1888, he served in the mills of the Pittsburgh Wire Company and later became superintendent

James A. Farrell

and manager. Subsequently, he served as general superintendent of the Oliver Steel Wire Company and as general manager of the Oliver Iron & Steel Company. Mr. Farrell took part in the organization of the Pittsburgh Wire Company, Braddock, Pa., which company later became part of the American Steel & Wire Company, of which he was general manager of exports until 1903. In the latter part of that year he was given supervision over the export sales of all other manufacturing units of the United States Steel Corporation as president of the newly-formed United States Steel Products Export Company, New York. Mr. Farrell left this company in January, 1911, to become president of the United States Steel Corporation.

John M. Sellers, president of the Sellers Manufacturing Company, Chicago, died at his home in Downers Grove, Ill., a suburb of Chicago, on March 13, following a heart attack. He was born at Keokuk, Iowa, on August 12, 1865, and in 1886 entered the employ of Morris Sellers & Co., which was organized in 1878 by his father. After working for this company for six years, he went to the Missabe Iron Range, where in 1893-1894 he discovered and developed the Sellers mine near Hibbing, Minn. In 1895, when the Sellers Manufacturing Company succeeded Morris Sellers & Co., he became vice-president and general manager. In 1915 he was elected president, which position he held until his death.

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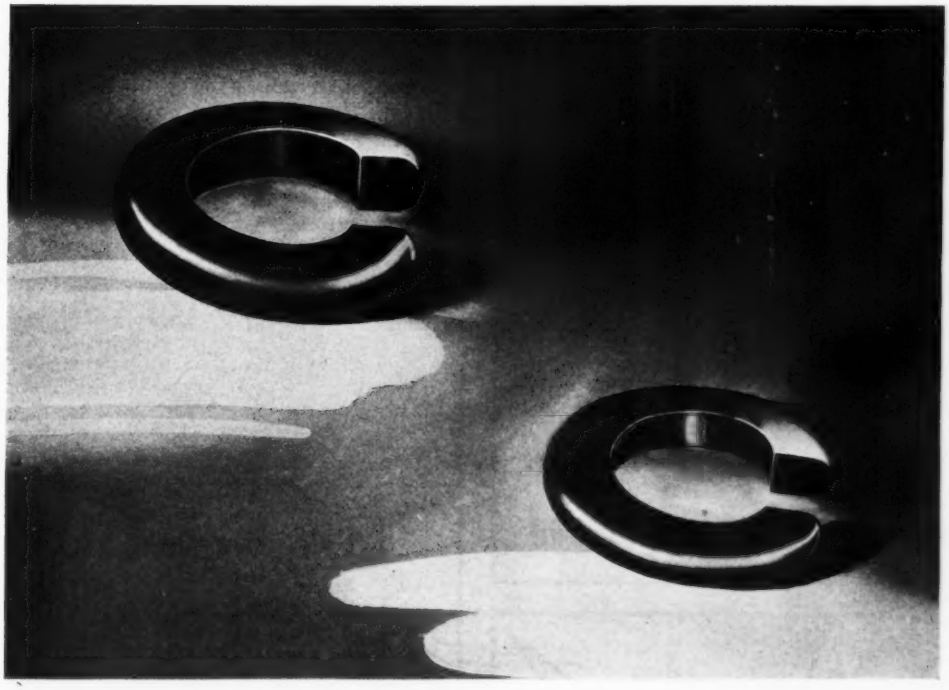

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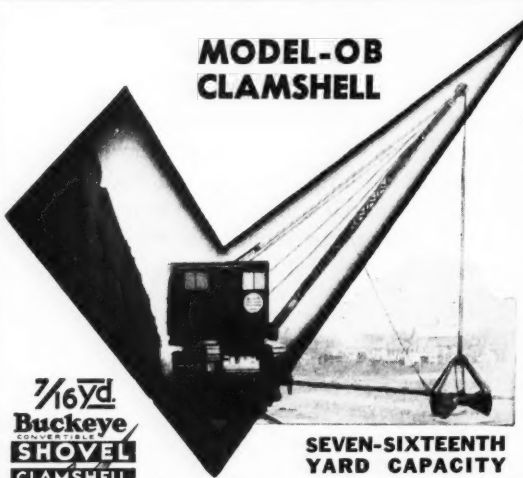

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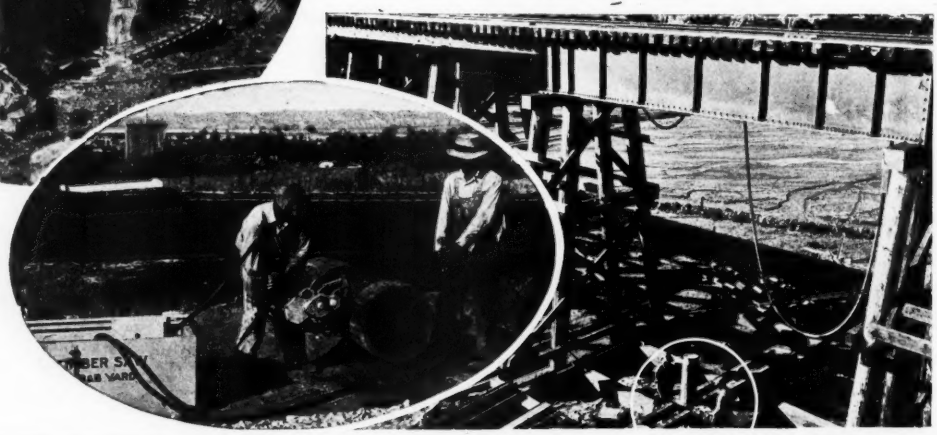

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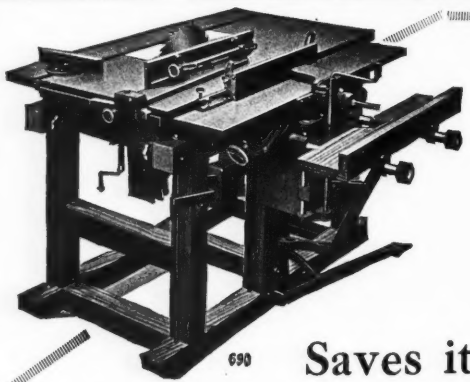

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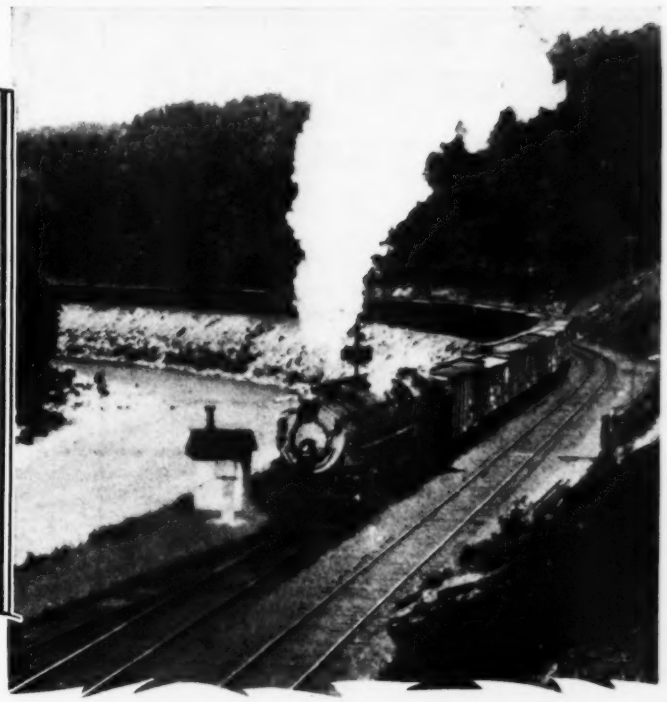

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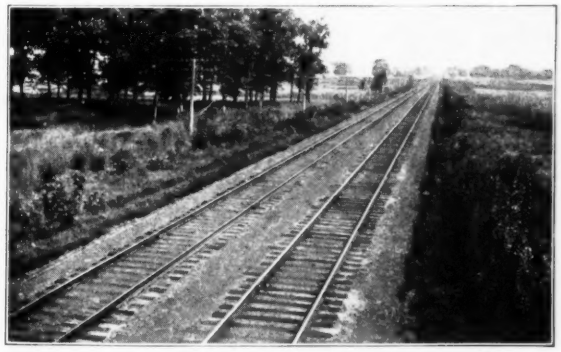

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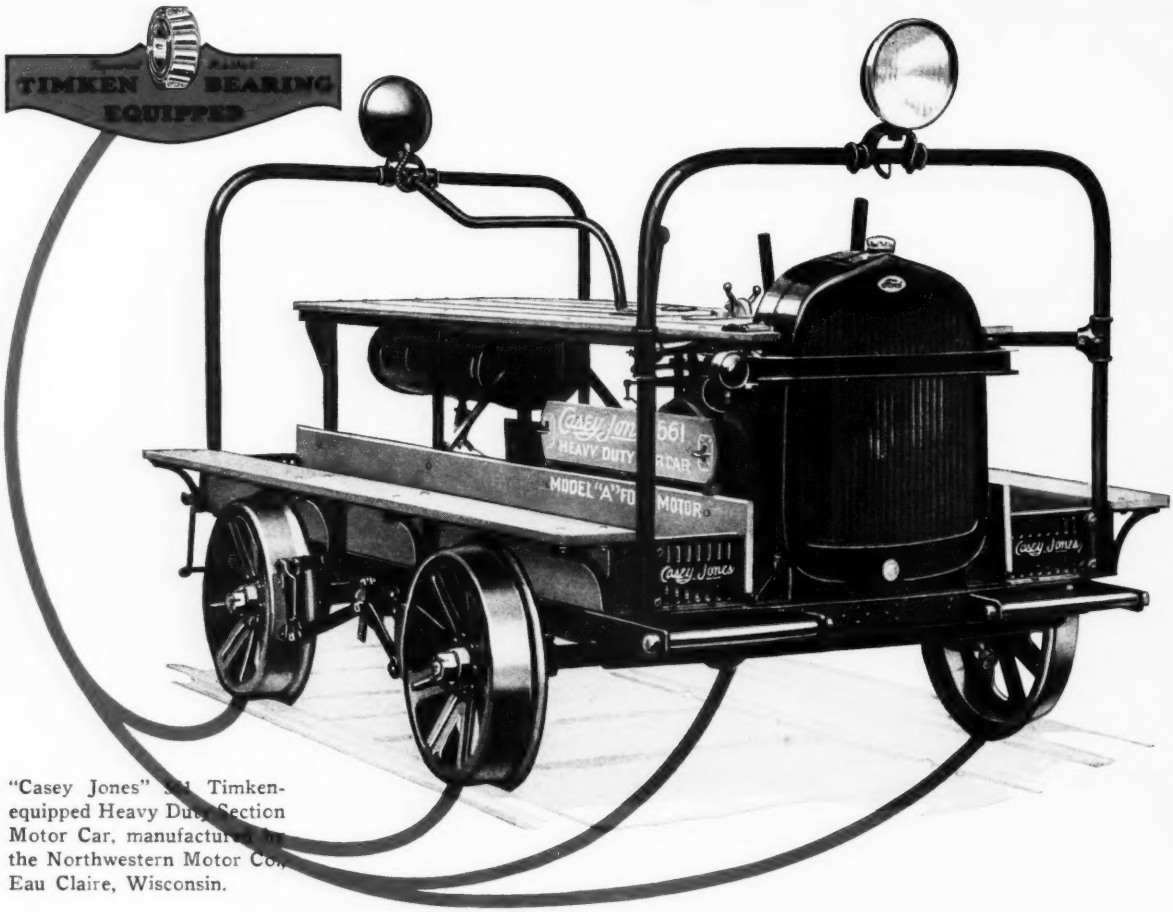

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